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ABSTRACT

This twenty-nine-unit residential plumbing curriculum contains teacher and student materials based on the Vocational-Technical Education Consortium of States (V-TECS) Plumbing Catalog of Performance Objectives, Performance Guides, and Tool and Equipment Lists. An introduction contains a V-TECS task listing showing the relationship between the catalog and the resulting instructional materials, including the rationale for excluding tasks. The twenty-nine units are divided into seven sections which cover these topics: orientation (4 units); Tools and Equipment (5 units); Residential Systems (4 units); Fixture and Appliance Installation (4 units); and System Maintenance and Repair (2 units). Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives (both unit and specific), suggested activities for teachers and students, information sheets, assignment sheets, job sheets (with evaluation), visual aids, tests, and answers to the tests. Units are planned for more than one lesson or class period of instruction. Bibliographic material is cited for suggested references for each unit. (YLB)

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ED187891

RESIDENTIAL PLUMBING

By

Leney Barclay

Developed by the
Mid-America Vocational Curriculum Consortium, Inc.

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FOREWARD

Residential Plumbing marks the beginning of a new effort to develop the very best in instructional materials for vocational programs. The Mid-America Vocational Curriculum Consortium (MAVCC) was organized for the prupose of developing instructional material for the twelve member states. During the last five years, MAVCC has developed quality materials for several areas which were identified as needs by the member states. To add assurance to the user as to the accuracy of these materials, MAVCC has worked cooperatively with the Vocational-Technical Education Consortium of States (V-TECS) to develop a set of materials based on the tasks they have identified as necessary for employment in the trade.

The success of this publication is due, in large part, to the capabilities of the personnel who worked with its development. The technical writer has numerous years of industry as well as teaching experience. Assisting him in his efforts were representatives of each of the member states who brought with them technical expertise and experience related to the classroom and to the trade. To assure that the materials would parallel the industry environment and be accepted as a transportable basic teaching tool, in addition to V-TECS, other organizations and industry representatives were involved in the developmental phases of the manual. Appreciation is extended to them for their valuable contributions to the manual.

This publication is designed to assist teachers in improving instruction. As this publication is used, it is hoped that the student performance will improve and that students will be better able to assume a role in their chosen occupation. Every effort has been made to make this publication basic, readable, and by all means usable. Three vital parts of instruction have been intentionally omitted: motivation, personalization, and localization. These areas are left to the individual instructors who should capitalize on them. Only then will this publication really become a vital part of the teaching-learning process.

Instructional materials in this publication are written in terms of student performance using measurable objectives. This is an innovative approach to teaching that accents and augments the teaching/learning process. Criterion referenced evaluation instruments are provided for uniform measurement of student progress. In addition to evaluating recall information, teachers are encouraged to evaluate the other areas including process and product as indicated at the end of each instructional unit.

It is the sincere belief of MAVCC personnel and all those members who served on the committees that this publication will allow students to become better prepared and more effective members of the work force. If there is anything that we can do to help this publication become more useful to you, please let us know.

Pat Lindley, Chairman
Board of Directors
MAVCC

Ann Benson, Executive Director
MAVCC

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PREFACE

This is the first time V-TECS materials have been used in the development of instructional materials with another agency. The idea for this collaborative effort came from a meeting of the State Directors of Vocational Education in Washington, D.C. during the spring of 1978.

The joint endeavor has produced many benefits to both V-TECS and MAVCC. For example, the materials developed for the "Residential Plumbing" curriculum are, in large part, based on the V-TECS "Plumbing Catalog of Performance Objectives, Performance Guides, and Tool and Equipment List."

The V-TECS task listing included in the introduction shows the relationship between the catalog and the resulting instructional materials, including the rationale for excluding tasks.

In this, our first attempt, strengths and weaknesses will be found. The user must decide whether or not the materials are acceptable. To assist in making this judgement, persons familiar with the V-TECS system may find the "Instructional Materials Assessment Checklist" helpful. (This is available through the V-TECS central office.) It contains the criteria against which materials may be measured acceptable or unacceptable in the competency-based mode of teaching/learning.

The most important function educators could perform is that of providing feedback to the producers of these curriculum materials which will be used to make decisions about their continuation, expansion, or improvement. We hope you will.

K.M. Eaddy, Director
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USE OF THIS PUBLICATION

Instructional Units

The *Residential Plumbing* curriculum includes 29 units. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities for teachers and students, information sheets, assignment sheets, job sheets, visual aids, tests, and answers to the test. Units are planned for more than one lesson or class period of instruction.

Careful study of each instructional unit by the teacher will help determine:

A. The amount of material that can be covered in each class period
B. The skills which must be demonstrated
   1. Supplies needed
   2. Equipment needed
   3. Amount of practice needed
   4. Amount of class time needed for demonstrations
C. Supplementary materials such as pamphlets or filmstrips that must be ordered
D. Resource people who must be contacted

Objectives

Each unit of instruction is based on performance objectives. These objectives state the goals of the course, thus providing a sense of direction and accomplishment for the student.

Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the student performance necessary to reach the unit objective.

Since the objectives of the unit provide direction for the teaching-learning process, it is important for the teacher and students to have a common understanding of the intent of the objectives. A limited number of performance terms have been used in the objectives for this curriculum to assist in promoting the effectiveness of the communication among all individuals using the materials.

Following is a list of performance terms and their synonyms which may have been used in this material:

Name
Label
List in writing
List orally
Letter
Record
Repeat
Give

Identify
Select
Mark
Point out
Pick out
Choose
Locate

Describe
Define
Discuss in writing
Discuss orally
Interpret
Tell how
Tell what
Explain

Order
Arrange
Sequence
List in order
Classify
Divide
Isolate
Sort

Distinguish
Discriminate

Construct
Draw
Make
Build
Design
Formulate
Reproduce
Transcribe
Reduce
Increase
Figure

Demonstrate
Show your work
Show procedure
Perform an experiment
Perform the steps
Operate
Remove
Replace
Turn off/on
(Dis) assemble
(Dis) connect

Additional Terms Used
Evaluate
Complete
Analyze
Calculate
Estimate
Plan
Observe
Compare
Determine
Perform

Prepare
Make
Read
Tell
Teach
Converse
Lead
State
Write

Reading of the objectives by the student should be followed by a class discussion to answer any questions concerning performance requirements for each instructional unit.

Teachers should feel free to add objectives which will fit the material to the needs of the students and community. When teachers add objectives, they should remember to supply the needed information, assignment and/or job sheets, and criterion tests.

Suggested Activities

Each unit of instruction has a suggested activities sheet outlining steps to follow in accomplishing specific objectives. The activities are listed according to whether they are the responsibility of the instructor or the student.

Instructor: Duties of the instructor will vary according to the particular unit; however, for best use of the material they should include the following: provide students with objective sheet, information sheet, assignment sheets, and job sheets; preview filmstrips, make transparencies, and arrange for resource materials and people; discuss unit and specific objectives and information sheet; give test. Teachers are encouraged to use any additional instructional activities and teaching methods to aid students in accomplishing the objectives.

Students: Student activities are listed which will help the student to achieve the objectives for the unit.

Information Sheets

Information sheets provide content essential for meeting the cognitive (knowledge) objectives in the unit. The teacher will find that the information sheets serve as an excellent guide for presenting the background knowledge necessary to develop the skill specified in the unit objective.

Students should read the information sheets before the information is discussed in class. Students may take additional notes on the information sheets.

Transparency Masters

Transparency masters provide information in a special way. The students may see as well as hear the material being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information sheets. They are particulary effective when identification is necessary.

Tranperencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. (NOTE: Stand away from the overhead projector when discussing transparency material. The noise of the projector may cause the teacher to speak too loudly.)

Assignment Sheets

Assignment sheets give direction to study and furnish practice for paper and pencil activities to develop the knowledges which are necessary prerequisites to skill development. These may be given to the student for completion in class or used for homework assignments. Answer sheets are provided which may be used by the student and/or teacher for checking student progress.

Job Sheets

Job sheets are an important segment of each unit. The instructor should be able to and in most situations should demonstrate the skills outlined in the job sheets. Procedures outlined in the job sheets give direction to the skill being taught and allow both student and teacher to check student progress toward the accomplishment of the skill. Job sheets provide a ready outline for students to follow if they have missed a demonstration. Job sheets also furnish potential employers with a picture of the skills being taught and the performances which might reasonably be expected from a person who has had this training.

Test and Evaluation

Paper-pencil and performance tests have been constructed to measure student achievement of each objective listed in the unit of instruction. Individual test items may be pulled out and used as a short test to determine student achievement of a particular objective. This kind of testing may be used as a daily quiz and will help the teacher spot difficulties being encountered by students in their efforts to accomplish the unit objective. Test items for objectives added by the teacher should be constructed and added to the test.

Test Answers

Test answers are provided for each unit. These may be used by the teacher and/or student for checking student achievement of the objectives.

*LISTING OF V-TECS TASKS USED IN THIS PUBLICATION

SECTION	UNIT	TASK
Orientation	General Safety	Plan safety programs
Tools and Equipment	Plumbing Truck	Take inventory of plumbing fixtures and supplies
	Basic Hand Tools	Demonstrate the use of equipment and tools
	Basic Hand Tools	Cut copper tubing and pipe with hacksaw
	Basic Hand Tools	Thread steel pipe with nonadjustable die
	Power Tools	Thread steel pipe with power driven vise stand
	Equipment	Prepare a tripod and transit level for use
Blueprints, Measurements, and Calculations	Building and Plumbing Codes	Determine local requirements for plumbing system construction
	Rough-In Locations	Establish grade lines for installing plumbing
	Rough-In Locations	Lay out house drains
	Rough-In Locations	Make water tests on building drains
	Rough-In Locations	Rough-in waste lines and vents for floor mounted water closets
	Rough-In Locations	Rough in waste lines and vents for shower baths
Systems Rough-In	Pipe	Secure permits for installation of plumbing systems
	Drainage Systems	Inspect plumbing systems
	Water Systems	Size plumbing supply systems
	Joining Pipes	Bend copper tubing with spring bender
	Joining Pipes	Join cast iron soil pipe, using lead and oakum

* Obtained in agreement with Vocational-Technical Education Consortium of States

SECTION	UNIT	TASK
Systems Rough-In Con't.	Joining Pipes	Cut cast iron soil pipe with snap-type chain cutter
	Joining Pipes	Cut copper tubing and pipe with tubing cutter
	Joining Pipes	Cut steel pipe with one-wheel pipe cutter
	Joining Pipes	Join cast iron pipe to clay pipe
	Joining Pipes	Wipe clay pipe joints
	Joining Pipes	Join clay pipe with couplings
	Joining Pipes	Join copper tubing/pipe to copper pipe/tubing
	Joining Pipes	Join copper tubing/pipe to plastic pipe
	Joining Pipes	Join copper tubing with compressed connectors
	Joining Pipes	Join pipe with no-hub or band clamp couplings
	Joining Pipes	Join plastic pipe, using solvent cement method
	Joining Pipes	Join plastic pipe to steel pipe (information sheet)
	Joining Pipes	Join steel pipe to cast iron pipe with no-hub couplings
	Joining Pipes	Thread steel pipe with adjustable die
Systems Rough-In	Water Systems	Install expansion joints
	Water Systems	Install hot or cold water storage tanks
Systems Rough-In	Water Systems	Insulate water lines
	Water Systems	Make water pressure tests on water supply systems
	Water Systems	Rough-in water supply lines for bathtubs
	Water systems	Rough-in water supply lines for water closets
	Water Systems	Rough-in water supply lines for water heaters

Systems Rough-In Con't.	Drainage System	Lay out trench lines
	Drainage System	Back fill trenches
	Drainage System	Calculate the slope required for building sewer lines
	Drainage Systems	Install drain pipe in trenches
	Drainage Systems	Install clean outs on drains
	Drainage Systems	Install storm drains
	Drainage Systems	Install soil or waste back vents
	Drainage Systems	Install vent terminals (roof flashing)
	Drainage Systems	Clear obstructions from lavatory drains
Private Systems	Private Water Systems	Compute the cost for plumbing supplies
	Water Systems	Cut steel pipe with four-wheel pipe cutter
	Septic Tanks and Field Drains	Install septic tanks
	Fuel Piping Systems	Perform leak tests on gas supply lines
	Fuel Piping Systems	Clean and adjust gas burners
Fixtures and Appliance Installation	Fixtures and Appliances	Join copper tubing to brass pipe
	Auxiliary Systems	Install lawn sprinkler systems
	Fixtures and Appliances	Install pressure relief valves
	Fixtures and Appliances	Install garbage disposal units
	Fixtures and Appliances	Install built-in lavatories
	Fixtures and Appliances	Install dishwashers
	Drainage Connections	Install pipe sleeves or thimbles through walls, ceilings, or floors
	Drainage Connections	Secure with hangers horizontal and vertical lines or pipe to masonry surfaces
	Drainage Connections	Secure with hangers horizontal and vertical lines of pipe to metal surfaces
	Drainage Connections	Secure with hangers horizontal and vertical lines of pipe to wood surfaces

Fixtures and Appliance Installation Con't.	Water Valves & Faucets	Install cut-off valves
	Water Valves & Faucets	Install cut-off valves in stop-and-waste box
	Fixtures and Appliances	Install electric waterheaters
	Fixtures and Appliances	Install gas water heaters
	Fixtures and Appliances	Install shower bath accessories in ceramic tile baths
	Fixtures and Appliances	Install tank type water closets
	Fixtures and Appliances	Install bathtubs
	Fixtures and Appliances	Install wall-mounted lavatories
Systems Maintenance and Repair	Drainage Systems Maintenance and Repair	Rough-in waste lines and vents for bathtubs
	Drainage Systems Maintenance and Repair	Rough-in waste lines and vents for built-in lavatories
	Drainage Systems Maintenance and Repair	Remove obstructions from main drain lines
	Drainage Systems Maintenance and Repair	Remove obstructions from water closet drains
	Drainage Systems Maintenance and Repair	Replace lavatory trap drains

TASKS WHICH HAVE NOT BEEN INCLUDED IN THE JOB SHEETS

REASON FOR NOT USING	TASK
Management level	Assign plumbing crews to tasks
	Determine performance standards for tasks
	Plan or schedule work assignments
	Write plumbing contracts
	Develop or improve task performance
	Evaluate tasks performed for compliance with work standards
	Evaluate individuals for promotion
	Evaluate procedures for storage or inventory of plumbing fixtures and supplies
	Evaluate work schedules or work load requirements
	Conduct on the job training
Commercial	Bend steel pipe
	Braze pipe with gas torch and filler metal
	Cut concrete pipe
Included in Information Sheets	Join copper tubing/pipe to plastic pipe using sweat method
	Join copper tubing to steel pipe
	Join plastic pipe to cast iron pipe with no-hub couplings

REASON FOR NOT USING	TASK
Commercial	Join pipe with electric arc welder and filler metal
	Install booster pumps in water supply lines
	Repair make-up water components on water cooling towers
	Install water circulating pumps
	Rough-in water supply lines for wall mounted urinals
	Install float valves on water cooling towers
	Install overflow pipes on water cooling towers
	Rough-in waste lines and vents for dishwashers
	Rough-in waste lines and vents for wall-mounted urinals
	Install acid proof traps
	Install grease interceptors in waste lines
	Install waste sinks for food-handling equipment
	Install drinking fountains
	Install flush valve-type water closets
Committee decision not to include	Install washing machines
Commercial	Install wall-mounted urinals
	Install water system components for hot water heating coils
	Install temperature and pressure relief valves on boilers
	Install check valves or water feed lines

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REASON FOR NOT USING	TASK
Commercial	Install package boilers
	Install strainers in condensate return lines
	Join branch mains to main steam piping
	Check steam pressures for boiler malfunctions
	Clean deposits from boilers
	Clean steam pressure regulator valves

PLUMBING BASIC TOOL BOX

Hacksaw
Vise grips - 10"
Pump pliers - 14"
12' steel tape
Line level
Plumb bob and line
Chalk line
Mail set
Center punch
Set pin punches
1/2 round file
Triangular file
Rasp
Expansive bit
Putty knife
Utility knife
Set cold chisels
6' zig zag rule
9" torpedo level
Set 1/2" socket wrenches
1/2" tubing cutter (#10)
Flaring tool
Swaging tool

Small hand saw
Keyhole (compass) saw
Needlenose pliers - 6"
6" crescent wrench
8" crescent wrench
12" crescent wrench
20 oz. straight claw hammer
2" flooring chisel
Nail puller
24" carpenter's level
Flat file, fine
Hand drill w/drills in handle
Bit brace (ratcheting)
Set twist drills
Set all steel wood chisels
Combination pattern snips
Magnetic or clutch finger pick-up tool
Set Phillips screwdrivers, including stubby and offset types
Set standard tip screwdrivers, including stubby and offset types
Set combination box/open end wrenches
6", 8", 12" pipe wrenches

SPECIALTY TOOL BOX

Basin wrench - 2 jawed speedy
14" 45° offset pipe wrench
18" offset
18" light duty chain wrench
#2 strap wrench
12" spud wrench (monkey type)
#25 hex wrench set
Internal pipe wrench
1/8" to 1" pipe taps
1/8" to 1" pipe extractors
No-hub torque wrench
Drum trap wrench
Radiator nipple wrench
Adjustable nut wrench

Plug wrench
Rimster screwdriver
Rinse quick wrench
P.O. plug wrench
Sink strainer wrench
Seat hinge wrench
Plumber's socket set
Alligator spud wrench
Tail piece flanging tool
Tapered utility wrench
Nut cracking tool
Faucet handle pulling tool
Aligning and pry bar
Set of taps and dies

SOLDERING AND TUBING KIT

1 - Midget tubing cutter

1 - #10 tubing cutter

1 - #20 tubing cutter

1 - #30 or #40 tubing cutter

1 - Internal tubing cutter #106

1 set Spring tube benders

1 - Flaring tool

1 set hammer flare tools

1 plumbers and steamfitters rule (6')

1 set swaging tools

1 - Copper cleaning tool #75

1 set Copper tubing outside cleaning brushes

1 set copper fitting cleaning brushes

1 - Tailpiece flanging tool

1 - Sparklighter (striker)

1 - Extra tips and parts for torches in use

1 set assorted files

Assorted wrenchs, screwdrivers, etc. to work on soldering equipment

1 - Pump pliers

1 - Inside/outside reamer

1 - Turbotorch unit and accessories

1 - Propane unit and accessories

THREADING EQUIPMENT

1 - Rigid power drive unit with accessories
1 - Nipple chuck set
1 - Adjustable pipe support
1 - Threading attachment - 2-1/2" - 4-1/2" Pipe
1 - Adjustable pipe support for threading attachment
1 - 4S Cutter
1 - 42A Cutter
1 - 2A Cutter
2 - Oilers with sumps
2 - Chain vises
1 set 12R pipe dies and handle
1 - Spiral reamer
1 set 1/8" - 2" pipe taps
1 - Screw and pipe extractor set to 2"
1 set bolt dies to fit machine
1 set beveline dies
1 set grooving dies
1 - #700 portable power drive
2 each assorted pipe wrenches to 4'

REPAIR TOOL KIT

Ballcock tube repair tool

Rigid #104 tubing cutter

Faucet handle puller

Bibb screw repair kit

Thread gauge

Seat tool set

Chicago reseating set

Speedy tubing die set

Speedy tube holder

Miscellaneous small wrenches, screwdrivers, etc.

Trap pump

Set hex wrenches

HOLE MAKING KIT

3/4 HP 2 speed angle drill (reversible)

Heavy duty extension cord

Set of masonry bits

Plumbers bit kit

18" extension shank

Deep cutting hole saw kit

Variable speed sawzall kit (saw and blades)

1/4" or 3/8" variable speed reversing drill

Index of high speed drills 1/16-1/2"

Set Allen wrenches

Center punch

OCCUPATIONAL INTRODUCTION
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to define terms associated with the occupational introduction to residential plumbing and match important events in the development of the history of residential plumbing to the correct dates. The student should also be able to select occupational fields related to residential plumbing, and list reasons why there are occupational opportunities for residential plumbers. This knowledge will be evidenced by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Define terms associated with the occupational introduction to residential plumbing.
2. Match seven important events in the development of residential plumbing to the correct dates.
3. List four job responsibilities of residential plumbers.
4. Select occupational fields related to residential plumbing.
5. List reasons why there are occupational opportunities for residential plumbers now and in the future.

F-1-A

OCCUPATIONAL INTRODUCTION
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.
   B. Provide student with information sheet.
   C. Discuss unit and specific objectives.
   D. Discuss information sheet.
   E. Discuss the working conditions of the residential plumber.
   F. Invite local plumbing contractor in to talk to class.
   G. Invite local advisory committee member to talk to class.
   H. Invite former students to talk to class.
   I. Give test.

II. Student:

   A. Read objective sheet.
   B. Study information sheet.
   C. Participate in class discussion about working conditions of the residential plumber.
   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet
   B. Information sheet
   C. Test
   D. Answers to test

II. Reference: *Plumbing Curriculum Development Project.* Salem, Oregon: Oregon State Department of Education, 1977.

P-3-A

OCCUPATIONAL INTRODUCTION
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Apprentice plumber--Person who is learning the trade through an organized program of on-the-job work experience and classroom/shop training

(NOTE: Apprentices usually apply for licenses after a four year training period.)

B. Journeyman plumber--Person who installs all the plumbing systems (drainage, venting, and water) in residential structures

(NOTE: Journeyman plumbers are also known as residential plumbers. Plumbers are usually licensed by state or local governments.)

C. Plumbing contractor--Person in the plumbing field who is licensed to perform plumbing work and who is legally capable of entering into contractual agreements with customers

(NOTE: Plumbing contractors are usually required to acquire a master plumber's license.)

II. Important events in the development of residential plumbing

A. 4500 B.C.--Flanged clay pipe used for sewer and water lines in Egypt

B. 3500 B.C.--Glazed clay pipe used for sewer and water lines on the island of Crete

C. 500 B.C.--Lead pipe used for water lines in Roman and Greek empires

(NOTE: Romans developed the name "plumber" from plumbum, the Latin) word for lead. A plumbarius was a worker in lead.)

D. A.D. 1400--Craft guilds formed

(NOTE: A guild was a group of craftsworkers of common interest, who were united by a strong organization.)

E. A.D. 1700--First apprenticeship laws passed (Europe)

F. A.D. 1855--First modern sewer system in the U.S. installed in Chicago.

G. A.D. 1937--National apprenticeship law passed

P-5-A

L

INFORMATION SHEET

III. Job responsibilities of residential plumbers

- A. Install drainage, vent, water, and gas supply pipes
- B. Install plumbing fixtures and appliances
- C. Perform maintenance work on existing plumbing systems
- D. Effectively communicate with customers

IV. Occupational fields related to residential plumbing

- A. Salesperson--Retail or wholesale selling positions with plumbing trade
- B. Counterman--Sales clerk in wholesale plumbing supply business
- C. Estimator--Person who develops estimated cost plus profit sheet for proposed plumbing contracts
- D. Sales respresentative--Person employed by manufacturer to aid retailers in promotion of a product
- E. Manufacturer's representative--Person who serves as liaison between the manufacturer and the retailer
- F. Inspector--Person who checks plumbing work to see if it conforms to the plumbing code
- G. Foreman--Person in charge of a specific group or crew doing plumbing work
- H. Superintendent--Person in charge of a large job or jobs, usually including several crews with foremen
- I. Building maintenance person--Person who specializes in maintaining plumbing facilities in specific buildings

V. Reasons why there are occupational opportunities for residential plumbers now and in the future

- A. Work is available due to the expanding economy in the construction field
- B. Work is available due to little automation in the construction field
- C. Work is available due to the continued standardization of practices through building codes, regulations, and testing
- D. Work is available due to customer demand for modern plumbing systems
- E. Work is available through self-employment
- F. Service and repair work is available due to prolonged use of plumbing installations

6-A

OCCUPATIONAL INTRODUCTION
UNIT I

NAME ______________________________

TEST

1. Define terms associated with the occupational introduction to residential plumbing.

   a. Apprentice plumber--

   b. Journeyman plumber--

   c. Plumbing contractor--

2. Match seven important events in the development of residential plumbing to the correct dates.

_____a. Flanged clay pipe used for sewer and water lines in Egypt	1. 1855 A.D.
	2. 500 B.C.
_____b. Glazed clay pipe used for sewer and water lines on the island of Crete	3. 3500 B.C.
_____c. Lead pipe used for water lines in Roman and Greek Empires	4. 4500 B.C.
	5. 1400 A.D.
_____d. Craft guilds formed	
	6. 1937 A.D.
_____e. First apprenticeship laws passed (Europe)	
	7. 1700 A.D.
_____f. First modern sewer system in the U. S. installed in Chicago, Illinois	
_____g. National apprenticeship law passed	

3. List four job responsibilities of residential plumbers.

   a.

   b.

   c.

   d.

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4. Select five occupational fields related to domestic plumbing by placing an "X" in the appropriate blanks.

_____a. Salesperson

_____b. Counterman

_____c. Diesel mechanic

_____d. Estimator

_____e. Appliance repairer

_____f. Sales representative

_____g. City firefighter

_____h. Foundry worker

_____i. Manufacturer's representative

_____j. Inspector

_____k. Building maintenance person

5. List four reasons why there are occupational opportunities for residential plumbers now and in the future.

a.

b.

c.

d.

S-A

OCCUPATIONAL INTRODUCTION
UNIT I

ANSWERS TO TEST

1. a. Person who is learning the trade through an organized program of on-the-job work experience and classroom/shop training

   b. Person who installs all the plumbing systems (drainage, venting, and water) in residential structures

   c. Person in the plumbing field who is licensed to perform plumbing work and who is legally capable of entering into contractual agreements with customers

2. a. 4
   b. 3
   c. 2
   d. 5
   e. 7
   f. 1
   g. 6

3. a. Install drainage, vent, water, and gas supply pipes

   b. Install plumbing fixtures and appliances

   c. Perform maintenance work on existing plumbing systems

   d. Effectively communicate with customers

4. a, b, d, f, i, j, k

5. Any four of the following:

   a. Work is available due to the expanding economy in the construction field

   b. Work is available due to little automation in the construction field

   c. Work is available due to the continued standardization of practices through building codes, regulations, and testing

   d. Work is available due to customer demand for modern plumbing systems

   e. Work is available through self-employment

   f. Service and repair work is available due to prolonged use of plumbing installations

HUMAN RELATIONS
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with the human relations required of a residential plumber and be able to distinguish between important aspects of employer-employee relationships. The student should also be able to explain the reasons for teamwork and select conditions which enhance good customer relations. This knowledge will be evidenced by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with human relations to the correct definitions.
2. Distinguish between employer expectations and employee expectations in their relationship.
3. Describe desirable personality traits and attitudes.
4. Explain reasons for teamwork.
5. Select those conditions which enhance good customer relations.
6. Complete a chart showing the distribution of income for a residential plumbing business.

P-11-A

HUMAN RELATIONS
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information sheet.

   C. Make transparency.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Discuss human relations as they apply to the residential plumber.

   G. Invite a plumbing contractor to speak to the class.

   H. Give examples of human relations.

   I. Give test.

II. Students:

   A. Read objective sheet.

   B. Study information sheet.

   C. Participate in class discussion on human relations.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency master

      1. TM 1--Distribution of Income for a Residential Plumbing Business

   D. Test

   E. Answers to test

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HUMAN RELATIONS
UNIT II

INFORMATION SHEET

I. Terms and definitions

  A. Employee--Person employed by another, usually for wages or salary

  B. Employer--Person who employs others usually for wages or salary

  C. Teamwork--Work done by several persons with each doing a part but all giving attention to the efficiency of the whole project

  D. Customer relations--Attitude, interest, and/or relationship of the customer in respect to the actions of any of the employees or employers of a sales business

II. Expectations of the employer and employee in their relationship

  A. Employer expectations

    1. Cooperation
    2. Honesty
    3. Initiative
    4. Willingness to learn
    5. Willingness to follow directions
    6. Dependability
    7. Enthusiasm
    8. Acceptance of objective criticism
    9. Loyalty and respect
    10. Full day's work for a full day's pay
    11. Notification of termination
    12. Productivity

  B. Employee expectations

    1. Salary
    2. Safe working conditions

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3. Training
4. Introduction to co-workers
5. Explanation of policies, rules, and regulations
6. Duty changes
7. Evaluation of work
8. Discipline for breaking rules
9. Honest relationship
10. Notification if employment is terminated
11. Respect

III. Desirable personality traits and attitudes

A. Adaptability--Adjusting easily to new situations

1. Accept changes without complaint
2. Learn new procedures and service information

B. Cooperation--Working harmoniously with others

1. Observe rules and regulations
2. Help others when possible
3. Work well with co-workers, supervisor, and employer

C. Courtesy--Being polite and having good manners

1. Show respect for employer
2. Show respect for the customer
3. Speak clearly and pleasantly
4. Return promptly from lunch and breaks so co-workers can have their rest periods

D. Dependability--Doing what a person says he/she will and completing duties assigned to him/her

1. Work regularly
2. Be on time
3. Take only the time allowed for lunch and breaks

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    4. Do all work assigned
    5. Follow instructions

E. Enthusiasm--Being eager to help or to take part in some activity

    1. Show pride in doing job
    2. Look alert
    3. Do more than one's share when time permits

F. Honesty--Being truthful in all things

    1. Be careful with money
    2. Give truthful information to employers, customers, and co-workers
    3. Keep promises
    4. Do not waste time

G. Initiative--Doing things without being told

    1. Be productive
    2. Use slack moments or leisure time to learn more about job
    3. Show an interest in learning and doing a good job
    4. Suggest ideas
    5. Anticipate needs for a job

H. Loyalty--Supporting a cause

    1. Keep confidences
    2. Avoid public criticisms of employer, supervisor, or co-workers
    3. Do not discuss wages or raises with other employees

I. Patience--Taking the time to do things right

    1. Try to understand the needs and desires of others
    2. Control anger

INFORMATION SHEET

J. Self-control--Being able to control one's temper and emotions

   1. Control temper

   2. Accept objective criticism

   3. Maintain poise

K. Tact--Being able to say the right thing at the right time

   1. Do not correct customers, co-workers, and employer in a disagreeable manner

   2. Learn to take care of customer complaints

IV. Reasons for teamwork

   A. Provides for the work to be done quickly

   B. Provides for the work to be equally shared

   C. Provides for heavy loads to be handled more easily

   D. Provides for a degree of comradeship rather than isolation

   E. Provides for difficult jobs to be done easily

V. Conditions which enhance good customer relations

   A. Honesty

   B. Courtesy and politeness

   C. Neatness and cleanliness

   D. Fairness

   E. Effective communications

   F. Promptness

VI. Distribution of income for a residential plumbing business (Transparency 1)

   A. Field costs

   (NOTE: Field costs include such items as materials, payroll, and inspection fees.)

   B. Overhead

   (NOTE: Overhead includes all office expenses.)

C. Advertising

D. Insurance

E. Phones (other than office phones)

F. Sub-contract

G. Uniforms

H. Rent (other than office rent)

I. Trucks

J. Employee benefits

K. Taxes

L. Profit

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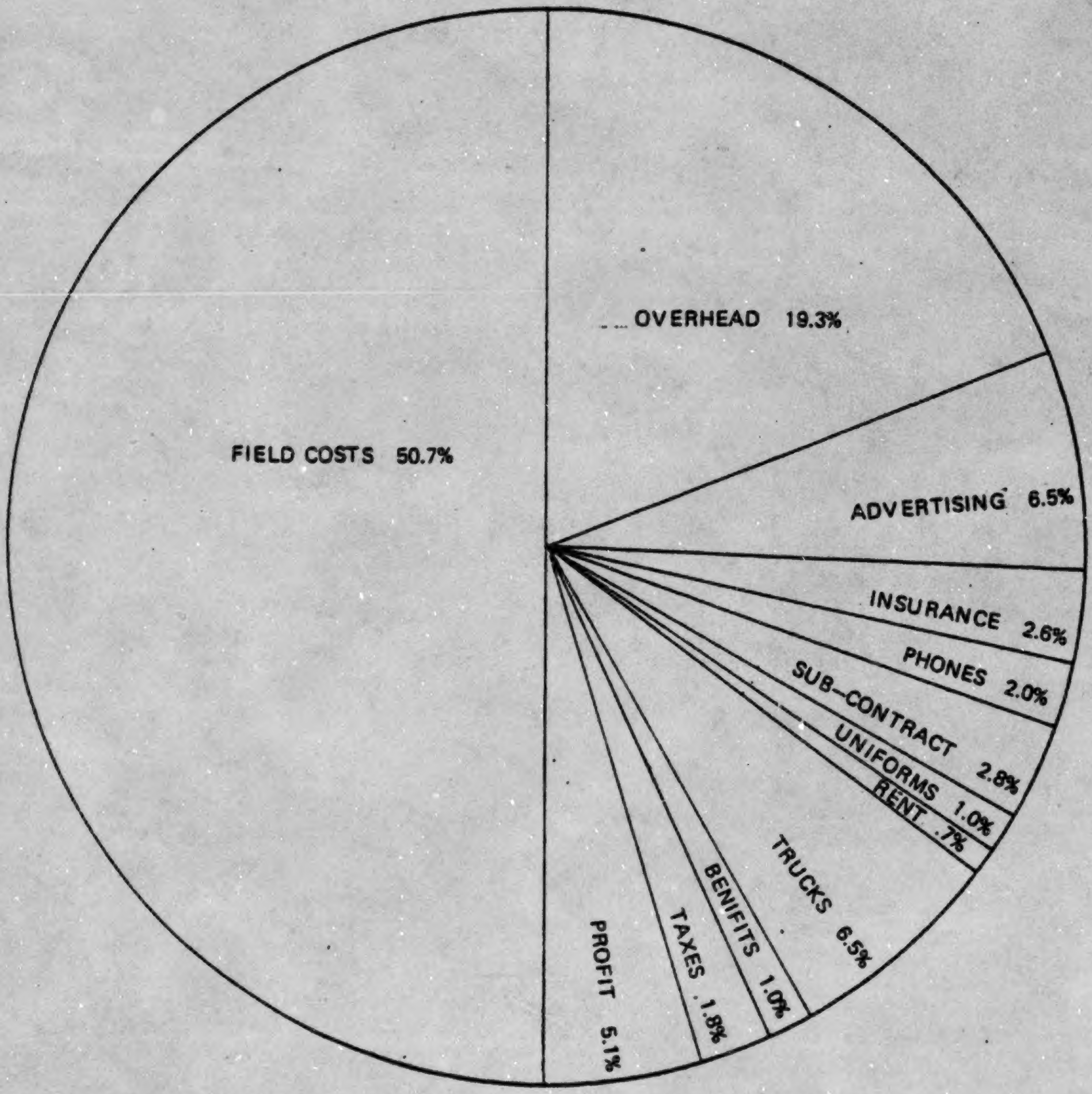
Distribution of Income for a Residential Plumbing Business



HUMAN RELATIONS
UNIT II

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions.

_____a. Attitude, interest and/or relationship of the customer in respect to the actions of any of the employees or employers of a sales business

_____b. Person who employs others usually for wages or salary

_____c. Work done by several persons with each doing a part but all giving attention to the efficiency of the whole project

_____d. Person employed by another, usually for wages or salary

1. Teamwork
2. Employee
3. Customer relations
4. Employer

2. Distinguish between employer expectations and employee expectations by placing an "X" next to employer expectations.

_____a. Cooperation

_____b. Initiative

_____c. Safe working conditions

_____d. Loyalty and respect

_____e. Explanation of policy, rules, and regulations

_____f. Discipline for breaking rules

_____g. Acceptance of objective criticism

_____h. Full day's work for a full day's pay

_____i. Notification of termination

_____j. Training

_____k. Evaluation of work

_____l. Dependability

_____m. Productivity

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3. Describe desirable personality traits and attitudes.

   a. Adaptability--

   b. Cooperation--

   c. Courtesy--

   d. Dependability--

   e. Enthusiasm--

   f. Honesty--

   g. Initiative--

   h. Loyalty--

   i. Patience--

   j. Self-control--

   k. Tact--

4. Explain four reasons for teamwork.

   a.

   b.

   c.

   d.

5. Select conditions which enhance good customer relations by placing an "X" in the appropriate blanks.

______a. Honesty
______b. Fairness
______c. Salary
______d. Neatness and cleanliness

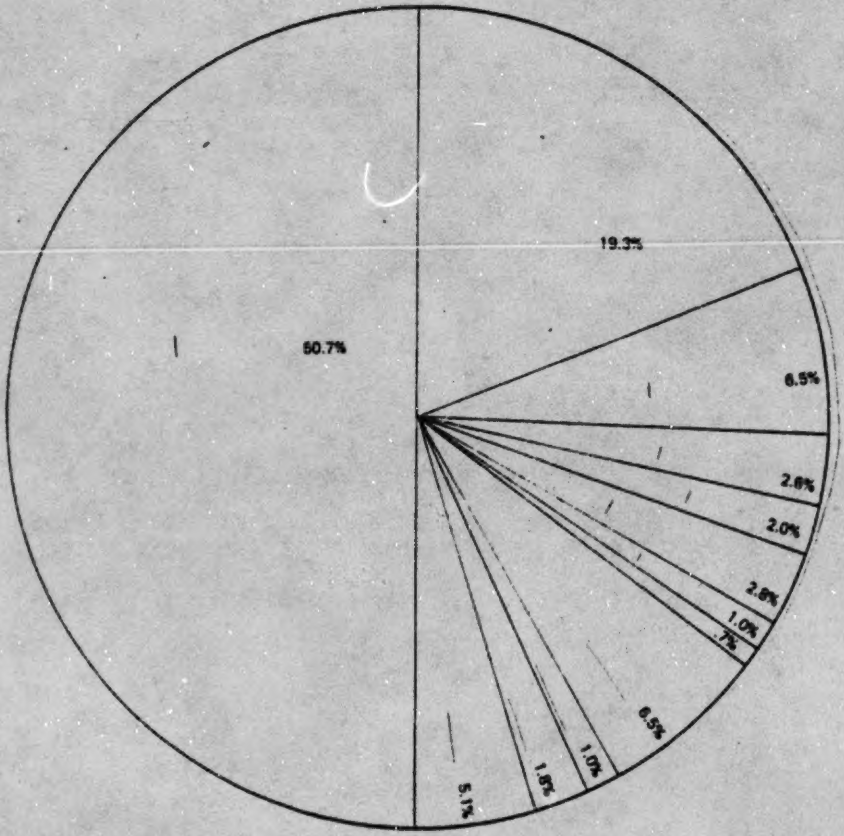
______e. Courtesy and politeness

______f. Demanding respect

______g. Promptness

______h. Effective communications

6. Complete the following chart showing the distribution of income for a residential plumbing business.



HUMAN RELATIONS
UNIT II

ANSWERS TO TEST

1. a. 3 c. 1

   b. 4 d. 2

2. a, b, d, g, h, i, l, m

3. Description should include:

   a. Adaptability--Adjusting easily to new situations

      1. Accept changes without complaint

      2. Learn new procedures and service information

   b. Cooperation--Working harmoniously with others

      1. Observe rules and regulations

      2. Help others when possible

      3. Work well with co-workers, supervisor, and employer

   c. Courtesy--Being polite and having good manners

      1. Show respect for employer

      2. Show respect for the customer

      3. Speak clearly and pleasantly

      4. Return promptly from lunch and breaks so co-workers can have their rest periods

   d. Dependability--Doing what a person says he/she will and completing duties assigned to him/her

      1. Work regularly

      2. Be on time

      3. Take only the time allowed for lunch and breaks

      4. Do all work assigned

      5. Follow instructions

e. Enthusiasm--Being eager to help or to take part in some activity

   1. Show pride in doing job
   2. Look alert
   3. Do more than one's share when time permits

f. Honesty--Being truthful in all things

   1. Be careful with money
   2. Give truthful information to employers, customers, and co-workers
   3. Keep promises
   4. Do not waste time

g. Initiative--Doing things without being told

   1. Be productive
   2. Use slack moments or leisure time to learn more about job
   3. Show an interest in learning and doing a good job
   4. Suggest ideas
   5. Anticipate needs for a job

h. Loyalty--Supporting a cause

   1. Keep confidences
   2. Avoid public criticisms of employer, supervisor, or co-workers
   3. Do not discuss wages or raises with other employees

i. Patience--Taking the time to do things right

   1. Try to understand the needs and desires of others
   2. Control anger

j. Self-control--Being able to control one's temper and emotions

   1. Control temper
   2. Accept objective criticism
   3. Maintain poise

k. Tact--Being able to say the right thing at the right time

   1. Do not correct customers, co-workers, and employer in a disagreeable manner

   2. Learn to take care of customer complaints

4. Any four of the following:

   a. Provides for the work to be done quickly

   b. Provides for the work to be equally shared

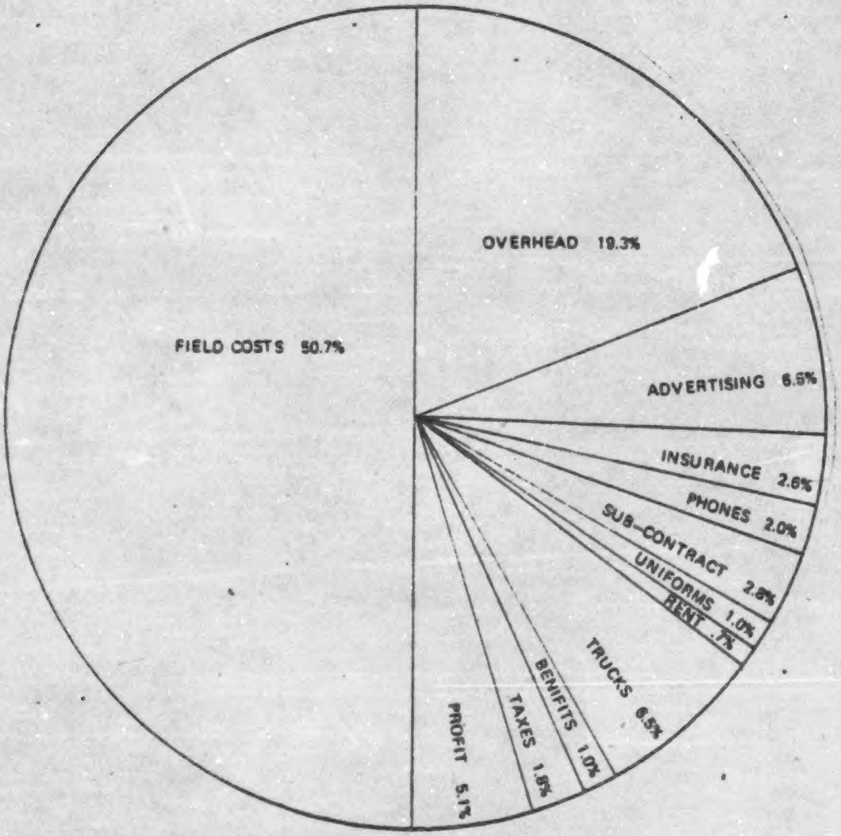
   c. Provides for heavy loads to he handled more easily

   d. Provides for a degree of comradeship rather than isolation

   e. Provides for difficult jobs to be done easily

5. a, b, d, e, g, h

6.



P-29-A

GENERAL SAFETY
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to list rules for personal safety and select rules for general shop and field safety. The student should also be able to select the correct fire extinguisher for the classes of fire and match the safety color code with statements of its use. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment sheet and by scoring 100 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with general safety to the correct definitions.
2. Match the seven colors of the safety color code to the correct applications of their use.
3. List rules for personal safety.
4. Select rules for general shop and field safety.
5. List steps in maintaining a clean and orderly shop.
6. Match the classes of fire to the correct statements defining each class.
7. Label the three components of the fire triangle.
8. Match the type or types of fire extinguishers to the class of fire they are used on.
9. Select steps to be followed in case of an accident in the plumbing shop.
10. Select the proper steps for lifting heavy objects.
11. Describe the steps to be followed in case of an accident.

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GENERAL SAFETY
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and assignment sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Show a safety film if available.

   G. Invite fire chief to give a talk on fire safety.

   H. Demonstrate the procedure for lifting a heavy object.

   I. Demonstrate evacuation plan.

   J. Have an accident victim address the class.

   K. Have a paramedic visit the class.

   L. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete assignment sheet.

   D. Complete activities assigned by instructor.

   E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

C. Transparency masters

   1. TM 1--The Fire Triangle

   2. TM 2--Types of Fire Extinguishers

   3. TM 3--Lifting

D. Assignment Sheet #1--Describe the Steps to be Followed in Case of an Accident

E. Answers to assignment sheet

F. Test

G. Answers to test

II. References:

A. *The ABC's of Fire Protection.* Belleville, New Jersey: Kidde Portable Extinguishers/Walter Kidde and Co., Inc.

B. *An Accident Prevention Program for School Shops and Laboratories.* Washington, D.C.: Office of Education/U.S. Department of Health, Education, and Welfare.

C. *Federal Register.* Vol. 36. Number 105. Part II. Department of Labor, May 29, 1971.

D. *Safety Practices and Procedures in School Shops.* Division of Vocational Education/New Jersey Department of Education.

E. *A Look at Service Safety.* Tecumseh, Michigan: Tecumseh Products Co.

III. Additional materials:

A. Film--"Housekeeping Means Safekeeping." 146-009. Journal Films Inc., 930 Pinter Avenue, Evanston, Illinois 60202.

B. Film--"Stop a Fire Before it Starts." 146-024, Journal Films, 909 West Diversey Parkway, Chicago, Illinois 60614.

GENERAL SAFETY
UNIT III

INFORMATION SHEET

I. Terms and definitions

   A. Safety--State or condition of being safe; freedom from danger, risk, or injury

   B. Accident--Includes any suddenly occurring, unintentional event which causes injury or property damage

   C. First aid--Immediate, temporary care given the victim of an accident or sudden illness until the services of a physician can be obtained

   D. O.S.H.A.--Occupational Safety and Health Act; federal legislation designed to insure safe and sanitary working conditions for employees

   (NOTE: Refer to your own state organization.)

II. Colors and applications of the safety color code

(NOTE: Refer to the National Safety Code.)

   A. Federal safety red

      1. Location of fire fighting equipment

      2. Portable containers of flammable liquids

      3. Emergency stop bars, stop buttons, and emergency electrical stop switches on machinery

   B. Federal safety yellow

      1. Caution and for marking physical hazards

      2. Waste containers for explosive or combustible materials

      3. Caution against starting, using, or moving equipment under repair

      4. Identification of the starting point or power source of machinery

   C. Federal safety orange

      1. Dangerous parts of machines

      2. Safety starter buttons and parts of equipment that may cause electrical shock

      3. Exposed parts (edges only) of pulleys, gears, rollers, cutting devices, and power jaws

   D. Federal safety purple--Radiation hazards

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INFORMATION SHEET

E. Federal safety green

   1. Safety

   2. Location of first aid equipment

      (NOTE: This applies to equipment other than fire fighting equipment.)

F. Federal safety black

   1. Traffic flow

   2. Housekeeping purposes

G. Federal safety white

   1. Traffic flow

   2. Housekeeping purposes

(NOTE: Black and white are used individually or in combination.)

III. Rules for personal safety

   A. Wear shop clothing appropriate to the instructional activity being performed

   B. Confine long hair before operating rotating equipment

   C. Always wear safety glasses; use suitable helmets and goggles for welding

   D. Remove ties when working around machine tools or rotating equipment

   E. Remove all metal jewelry when working

   F. Conduct oneself in a manner conducive to safe practices

   G. Use soap and water frequently as a method of preventing skin irritation

IV. Rules for general shop and field safety

   A. Tools and equipment

      1. Keep all hand tools sharp, clean, and in safe working order

      2. Report any defective tools, machines, or other equipment to the instructor

      3. Retain all guards and safety devices except with the specific authorization of the instructor

4. Operate a hazardous machine only after receiving instruction on how to operate the machine safely
5. Turn off the power before leaving a power tool
6. Make sure all guards and barriers are in place and adjusted properly before starting a machine tool
7. Disconnect the power from machine tools before performing the maintenance task of oiling or cleaning
8. Use a solvent only after determining its properties, what kind of work it has to do, and how to use it
9. Use correct, properly fitting wrenches for nuts, bolts, and objects to be turned or held
10. Use proper tools and equipment for the proper job
11. All revolving machine parts should be well guarded
12. Do not run over extension or drop cords with appliance dolly
13. Do not leave tools on the floor
14. Make sure everyone is clear if using compressed air to clean

B. Accidents and safety

1. Report all accidents to the instructor regardless of nature or severity
2. Wear safety clothing such as goggles, gloves, shoes, and aprons when welding
3. Consider the safety of others when working in the shop
4. Report any condition that may lead to an accident
5. Watch the bulletin board for safety information and notices
6. Conduct oneself in a safe-like manner at all times
7. Do not throw any object
8. Control temper and don't take chances
9. Wear gloves when handling material with sharp edges
10. Operate equipment and machines only when permitted by instructor
11. Do not distract the attention of a machine operator while working

12. Do only approved work in shop

13. Check all equipment before turning on switch

14. Do not work in the dark; use plenty of light

15. All accidents should be recorded in writing

16. All injuries must be given prompt attention

17. Do not work overtime in the shop without the instructor being present

C. Housekeeping

1. Keep the shop or job site floor clear of scraps and litter

2. Clean up any spilled liquids immediately

3. Store oily shop towels or oily waste in metal containers

4. Clean the chips from a machine with a brush; do not use a towel, bare hands or compressed air

V. Steps in maintaining a clean and orderly shop

A. Machinery and equipment arranged to permit safe, efficient work practices and ease in cleaning

B. Materials and supplies safely stacked or stored in proper places

C. Tools and accessories safely stored in cabinets, on racks, or other suitable devices

D. Working areas and work benches clear and free of debris and other hazards

E. Floors clean and free from obstructions and slippery substances

F. Aisles, traffic areas, and exits free of materials and other debris

G. Combustible materials properly disposed of or stored in approved, labeled containers

H. Oily towels stored in approved metal containers

I. Students working in the area instructed on the proper procedures to follow in keeping the area clean and orderly

J. Sufficient brooms, brushes, and other housekeeping equipment readily available

K. Drinking fountain and wash facilities should be kept clean and neat at all times

INFORMATION SHEET

VI. Classes of fires

A. Class A--Fires that occur in ordinary combustible materials

Examples: Wood, rags, and rubbish

B. Class B--Fires that occur with flammable liquids

Examples: Gasoline, oil, grease, paints, and thinners

C. Class C--Fires that occur in or near electrical equipment

Examples: Motors, switchboards, and electrical wiring

D. Class D--Fires that occur with combustible metals

Example: Magnesium

VII. Components of the fire triangle (Transparency 1)

A. Fuel--Any combustible material

B. Heat--Enough to raise the fuel to its ignition temperature

C. Oxygen--Necessary to sustain combustion

(NOTE: To produce fire these three elements are necessary and must be present at the same time. If any one of the three is missing, a fire cannot be started. With the removal of any one of them, the fire will be extinguished.)

VIII. Types of fire extinguishers and classes of fires (Transparency 2)

A. Pressurized water--Operates usually by squeezing a handle or trigger; used on Class A fires

B. Soda acid--Operates by turning extinguisher upside down; used on Class A fires

C. Carbon dioxide (CO_2)--Operates usually by squeezing handle or trigger; used on Class B and C fires

D. Dry chemical--Operates usually by squeezing a handle, trigger, or lever; used on Class B, C, and D fires

(NOTE: On Class D fires, dry sand is as effective as any dry chemical other than Purple X. The cost of the Purple X chemical places it out of reach of most shops.)

E. Foam--Operates by turning extinguisher upside down; used on Class A and B fires

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INFORMATION SHEET

IX. Steps to be followed in case of an accident in the shop

A. Report all accidents and injuries to the instructor no matter how minor they may seem

B. First aid will be administered if needed

(NOTE: Check with local school policy.)

C. Student will be taken to school nurse

D. Student's parent or guardian will be notified if school nurse requires student to see a physician

F. Investigation of the accident will take place to determine the cause of the accident and determine ways to prevent the sama accident from happening again

G. Accident report form will be filled out by instructor

X. Steps for lifting heavy objects (Transparency 3)

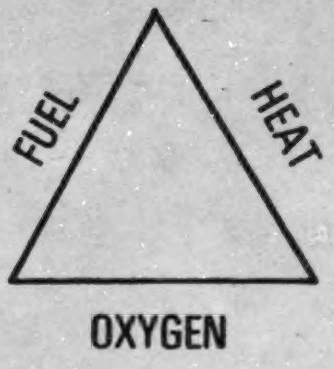
A. Bend knees

B. Keep back straight

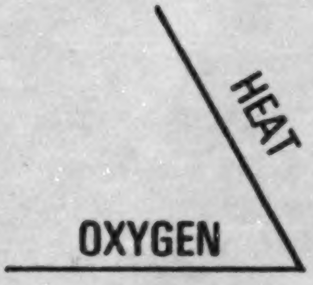
C. Lift gradually with leg muscles

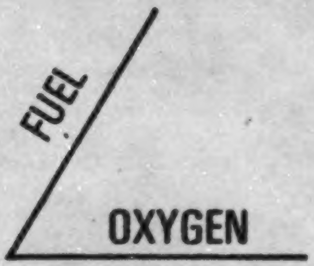
The Fire Triangle

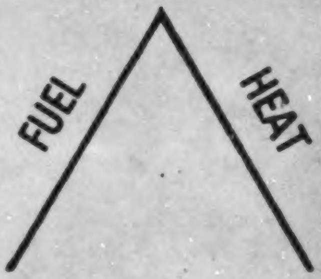
To produce fire, three things must be present at the same time.


FUEL
HEAT
OXYGEN

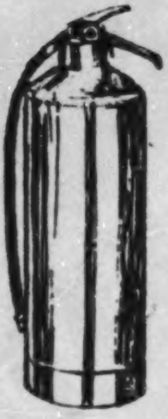
If any one of the three is missing, a fire cannot be started or, with the removal of any one, the fire will be extinguished.


HEAT
OXYGEN


FUEL
OXYGEN

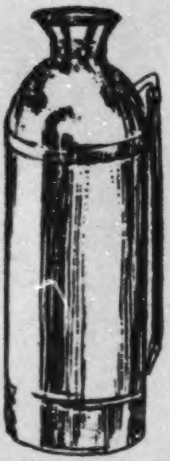


Types of Fire Extinguishers



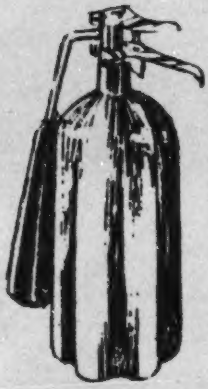
Pressurized Water

Class A



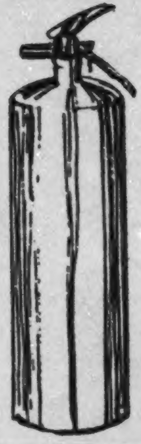
Soda-Acid

Class A



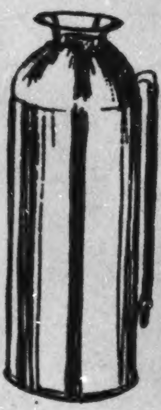
Carbon Dioxide

Class B and C



Dry Chemical

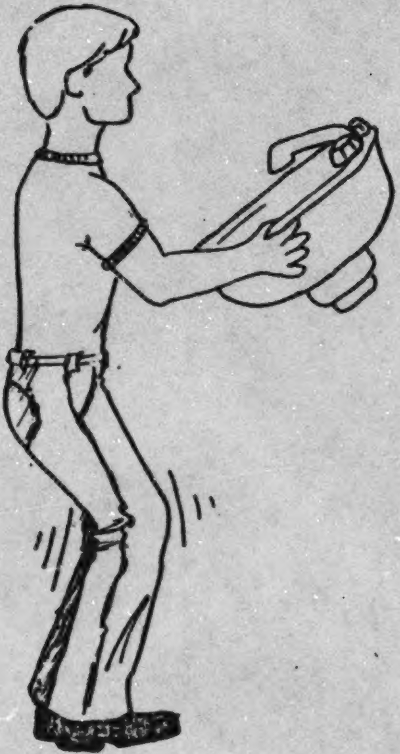
Class B, C, and D



Foam

Class A and B

Lifting



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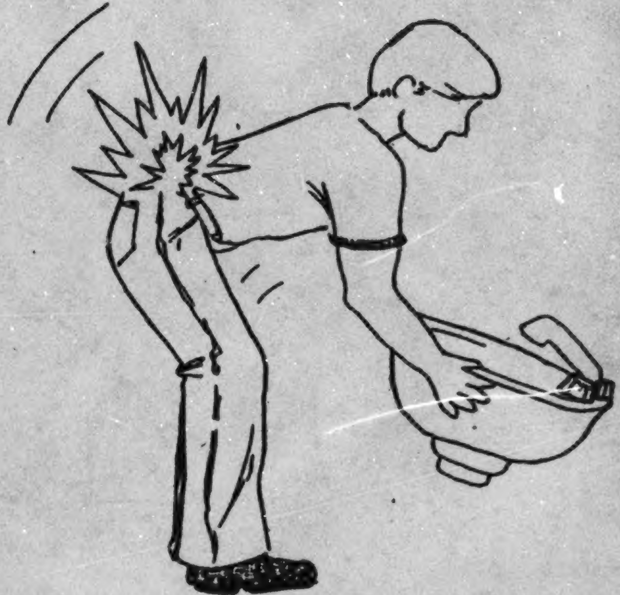

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GENERAL SAFETY
UNIT III

ASSIGNMENT SHEET #1–DESCRIBE THE STEPS TO BE FOLLOWED IN CASE OF AN ACCIDENT

Given the accident below, discuss the steps to be followed and state the safety rule that would have prevented the accident from occurring.

A student is removing a sheet metal panel and cuts the palm of his hand to the bone.

P-47-A
[illegible]

ANSWERS TO ASSIGNMENT SHEET #1

Discussion should include:

1. Report all accidents and injuries to the instructor no matter how minor they may seem
2. First aid will be administered if needed

   (NOTE: Check with local school policy.)
3. Student will be taken to school nurse
4. Student's parent or guardian will be notified if school nurse requires student to see a physician
5. Accident report form will be filled out by instructor
6. Investigation of the accident will take place to determine the cause of the accident and determine ways to prevent the same accident from happening again

The safety rule should be stated as follows:

Wear gloves when handling material with sharp edges.

GENERAL SAFETY
UNIT III

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions.

_____a. Immediate, temporary care given the victim of an accident or sudden illness until the services of a physician can be obtained

_____b. State or condition of being safe; freedom from danger, risk, or injury

_____c. Includes any suddenly occurring, unintentional event which causes injury or property damage

_____d. Occupational Safety and Health Act; federal legislation designed to insure safe and sanitary working conditions for employees

1. Safety
2. Accident
3. First aid
4. O.S.H.A.

2. Match the colors of the safety color code on the right to the correct applications of their use.

_____a. Caution and for marking physical hazards

_____b. Location of fire fighting equipment

_____c. Location of first aid equipment

_____d. Dangerous parts of machines

_____e. Housekeeping purposes

_____f. Traffic flow

_____g. Radiation hazards

1. Federal safety green
2. Federal safety white
3. Federal safety orange
4. Federal safety purple
5. Federal safety black
6. Federal safety red
7. Federal safety yellow

3. List five rules for personal safety.

a.

b.

c.

d.

e.

4. Select rules for general shop and field safety by placing an "X" in the appropriate blanks.

______a. Keep all hand tools sharp, clean, and in safe working order

______b. Operate a hazardous machine if you think you can operate the machine

______c. Report all accidents to the instructor regardless of nature or severity

______d. Leave the power on a machine tool so the next person may operate it

______e. Oil or clean machine tools with the power on

______f. Use correct, properly fitting wrenches for nuts, bolts, and objects to be turned or held

______g. Throw scraps and litter on the shop floor

______h. Let spilled liquids stay on the floor until they dry out

______i. Store oily shop towels or oily waste in metal containers

______j. Use bare hands to clean chips from a machine

______k. Wear safety clothing such as goggles, gloves, shoes, and aprons when welding

______l. Report any condition that may lead to an accident

______m. Show your temper and take chances while working in the shop

______n. Wear gloves when handling material with sharp edges

______o. Do not distract the attention of a machine operator while working

______p. Make sure everyone is clear if using compressed air to clean

______q. All revolving machine parts should be well guarded

5. List five steps in maintaining a clean and orderly shop.

a.

b.

c.

d.

e.

6. Match the classes of fire on the right to the correct statements defining each class.

_____a. Fires that occur with flammable liquids

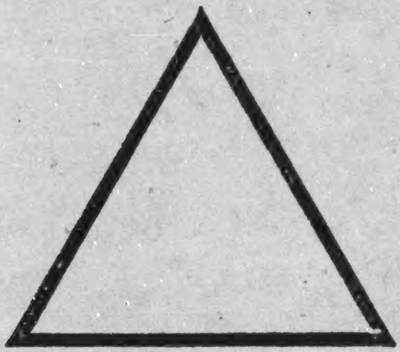
_____b. Fires that occur in ordinary combustible materials

_____c. Fires that occur in or near electrical equipment

_____d. Fires that occur with combustible metals

1. Class A
2. Class B
3. Class C
4. Class D

7. Label the three components of the fire triangle.



8. Match the type or types of fire extinguishers on the right to the class of fire they are used on.

_____ a. Class B

_____ b. Class C

_____ c. Class A

_____ d. Class D

1. Pressurized water
2. Carbon dioxide (CO_2)
3. Dry chemical
4. Soda acid
5. Foam

9. Select the steps to be followed in case of an accident in the plumbing shop by placing an "X" in the appropriate blanks.

______a. Investigation of the accident will take place to determine the cause of the accident and determine ways to prevent the same accident from happening again

______b. Apply a tourniquet

______c. Student's parent or guardian will be notified if school nurse requires student to see a physician

______d. First aid will be administered if needed

______e. Mouth-to-mouth resuscitation will be administered in all cases

______f. Student will be taken to school nurse

______g. Student will be required to sign an insurance release form before he or she can be helped

______h. Report all accidents and injuries to the instructor no matter how minor they may seem

______i. First mop up blood to prevent a slick spot on the floor

______j. Accident report form will be filled out by instructor

10. Select the proper steps for lifting heavy objects by placing an "X" in the appropriate blanks.

______a. Bend at the waist and lift straight up

______b. Keep back straight

______c. Straddle heavy objects before trying to lift

______d. Bend knees

______e. Lift in a quick jerking motion

______f. Lift gradually with leg muscles

11. Describe the steps to be followed in case of an accident

(NOTE: If this activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

GENERAL SAFETY
UNIT III

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 2
   d. 4

2. a. 7
   b. 6
   c. 1
   d. 3
   e. 2 and/or 5
   f. 2 and/or 5
   g. 4

3. Any five of the following:
   a. Wear shop clothing appropriate to the instructional activity being performed
   b. Confine long hair before operating rotating equipment
   c. Always wear safety glasses; use suitable helmets and goggles for welding
   d. Remove ties when working around machine tools or rotating equipment
   e. Remove all metal jewelry when working
   f. Conduct oneself in a manner conducive to safe practices
   g. Use soap and water frequently as a method of preventing skin irritation

4. a, c, f, i, k, l, n, o, p, q

5. Any five of the following:
   a. Machinery and equipment arranged to permit safe, efficient work practices and ease in cleaning
   b. Materials and supplies safely stacked or stored in proper place
   c. Tools and accessories safely stored in cabinets, on racks, or other suitable devices

d. Working areas and work benches clear and free of debris and other hazards.

e. Floors clean and free from obstructions and slippery substances

f. Aisles, traffic areas, and exits free of materials and other debris

g. Combustible materials properly disposed of or stored in approved, labeled containers

h. Oily towels stored in approved metal containers

i. Students working in the area instructed on the proper procedures to follow in keeping the area clean and orderly

j. Sufficient brooms, brushes, and other housekeeping equipment readily available

k. Drinking fountain and wash facilities should be kept clean and neat at all times

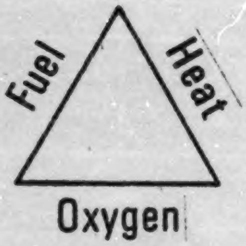
6. a. 2

   b. 1

   c. 3

   d. 4

7.



8. a. 2, 3, and 5

   b. 2 and 3

   c. 1, 4, and 5

   d. 3

9. a, c, d, f, h, j

10. b, d, f

11. Evaluated to the satisfaction of the instructor

APPLYING FOR A JOB
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to locate a job opening, make a formal application, and effectively interview for a job. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with applying for a job to the correct definitions.
2. List means of locating job openings.
3. List three methods of applying for a job.
4. Select personal attributes or attitudes an employer looks for during a personal interview.
5. Select guidelines for dressing for an interview.
6. List four items which an applicant may need to prepare when applying for a job.
7. Select guidelines to follow when participating in a job interview.
8. Write a resume.
9. Write a letter of application for a plumbing job.
10. Complete employment application form for a job as a plumber.
11. Practice interview questions.
12. Make an appointment by phone for a plumbing job interview.
13. Write a follow-up letter or make a follow-up phone call after interviewing for a plumbing job.
14. Evaluate a plumbing job offer.
15. Compare job opportunities.

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SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and assignment sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Invite resource person to discuss "What I look for on application letters, resumes, employment application forms, and follow-up devices" and "How do equal opportunity and affirmative action affect my hiring procedures?"

   G. Obtain actual letters of application and resumes to show to students.

   H. Give test.

II. Students:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete assignment sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

A. Objective sheet

B. Information sheet

C. Transparency masters

   1. TM 1--Attitudes

   2. TM 2--Appropriate Dress

   3. TM 3--Take Time to be on Time

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D. Assignment sheets

  1. Assignment Sheet #1--Write a Resume
  2. Assignment Sheet #2--Write a Letter of Application for a Plumbing Job
  3. Assignment Sheet #3--Complete Employment Application Form for a Job as a Plumber
  4. Assignment Sheet #4--Practice Interview Questions
  5. Assignment Sheet #5--Make an Appointment by Phone for a Plumbing Job Interview
  6. Assignment Sheet #6--Write a Follow-up Letter or Make a Follow-up Phone Call after Interviewing for a Plumbing Job
  7. Assignment Sheet #7--Evaluate a Plumbing Job Offer
  8. Assignment Sheet #8--Compare Job Opportunities

F. Test

G. Answers to test

III. Unit references:

A. Blackledge, Ethel H.; Blackledge, Walter L.; and Helen J. Keily. *You and Your Job.* Dallas: South-Western Publishing Company, 1967.

B. Milburn, Paul M. *How to Get a Job.* Shawnee, Oklahoma: Gordon Cooper Area Vocational Technical School, 1967.

C. Moynihan, Moynihan, and Daeger. *You and Your Job--How to Get It.* Chicago: J. G. Ferguson Publishing Company, 1968.

D. Wood, Merle W., and McKeena, Margaret. *The Receptionist.* Dallas: McGraw-Hill Book Company/Gregg Division, 1966.

E. *Can I Get the Job?* Detroit: General Motors Public Relations Staff, 1972.

F. Keeton, Marsha. *Job Application and Interview.* University of Kentucky: Vocational Education Curriculum Development Center of Kentucky, 1973.

G. *Interviewing Women Candidates.* Washington, D. C.: U. S. Civil Service Commission, 1974.

H. *Your Attitude Is Showing.* Austin, Texas: Instructional Materials, Division of Extension/University of Texas, 1972.

I. Allen, Cliff. "About Getting a Job" and "After High School--What?" *Practical Family Life.* Greenfield, Mass.: Channing L. Bete, Inc., 1977.

J. Kimbrell, Grady, and Vineyard, Ben S. *Succeeding in the World of Work.* Bloomington, Illinois: McKnight Publishing Company, 1975.

K. Feingold, S. Norman, and Swerdloff, Sol. *Occupations and Careers.* St. Louis: McGraw-Hill Book Company/Webster Division, 1969.

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APPLYING FOR A JOB
UNIT IV

INFORMATION SHEET

I. Terms and definitions

- A. Award--Recognition received for outstanding achievement
- B. Extracurricular activities--Clubs, organizations, and social or church groups in which one participates
- C. Fringe benefits--Extras provided by an employer, such as paid vacations, sick leave, and insurance protection
- D. Qualifications--Experience, education, and physical characteristics which suit a person to a job
- E. Resume--Brief, typed summary of one's qualifications and experience that is used in applying for a job
- F. Vocational preparation--Any vocational courses and skills one has learned in high school or through work experience
- G. Interview--Meeting of employer and job applicant for purpose of evaluation and questioning
- H. Application form--Printed form on which job applicants record information about their personal history, job history, job experience, education, and references
- I. Blind ad--Classified advertising that does not identify the advertiser

  (NOTE: Applicant is asked to send a letter of application and resume to a post office box number or to call a certain number.)
- J. Help wanted ad--Classified advertisement telling what kind of job is available and what the qualifications are
- K. Employment/situation wanted ad--Classified advertisement placed by individuals seeking employment and telling what their qualifications are
- L. Employment agency--Business that is designed to help individuals find employment
- M. Garnishee--To attach wages or other property to satisfy a debt
- N. Legible--Capable of being read; clear
- O. Equal opportunity employer--Employer who is making a special effort to assure that no form of discrimination is practiced

  Examples: Age, sex, race, creed

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INFORMATION SHEET

II. Means of locating job openings

- A. Classified ads
  - 1. Newspapers
  - 2. Magazines
- B. Employment offices
  - 1. Department of Labor
  - 2. Private

    (NOTE: A fee is charged by most private agencies.)
- C. Local labor union business office
- D. School officials
  - 1. Teacher
  - 2. Counselor
  - 3. Principal

III. Methods of applying for a job

- A. Letter
- B. Telephone
- C. In person

IV. Personal attributes or attitudes an employer looks for during a personal interview (Transparency 1)

- A. Enthusiasm and interest
- B. Dedication and dependability
- C. Alertness, quickness of mind
- D. Honesty and integrity
- E. Desire to work
- F. Desire to help others
- G. Desire to improve one's self

INFORMATION SHEET

V. Guidelines for dressing for an interview (Transparency 2)

   A. Job-related guidelines

      1. Kind of job

         (NOTE: A "rule of thumb" for any job interview is to dress better for the interview than you would for a day on the job.)

      2. Salary range

   B. Personal guidelines

      1. Coordinate clothing

      2. Be conservative

      3. Be modest and well-groomed

VI. Items which applicant may need to prepare when applying for a job (Assignment Sheets #1, #2, #3, and #6)

   A. Resume

   B. Letter of application

   C. Application form

   D. Follow-up letter

VII. Guidelines to follow when participating in a job interview (Transparency 3)

   A. Preparing for the interview

      1. Be clean

      2. Be well-groomed and neat

      3. Wear appropriate clothes and shoes for the type of job

      4. Take an ink pen and resume with the information you may need about social security number, references, names and addresses, dates employed, and dates attended school

      5. Go alone; do not take parents or friends

      6. Do not be late; allow enough time

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7. Find out facts about the interviewer ahead of time
    a. Name

       (NOTE: Make sure you have the correct pronunciation.)

    b. Title
8. Know facts about the business
    a. Name
    b. Kind of business
    c. Products and services
    d. Reasons you want to work there
    e. How old the company is and where the plants, offices, or stores are located

B. Meeting the receptionist/secretary

1. Smile
2. Introduce yourself, stating that you have an appointment

   Example: "Good morning. I am Terry McKracken and am applying for a job as a plumber. I have a 10:00 appointment with Mr. Smith."

3. Follow receptionist's/secretary's instructions
4. Wait patiently

C. Starting the interview

1. Smile
2. Listen
3. Enter with poise
4. Greet the interviewer by name
5. Shake hands firmly
6. Introduce yourself

7. State purpose of call

8. Be seated only at interviewer's invitation

9. Do not show signs of nervousness

   (NOTE: If you do not know where to put your hands, leave them on your lap and keep them still.)

10. Do not place personal things on interviewer's desk

11. Do not smoke or chew gum

12. Look alert; look interested and enthusiastic

    (NOTE: Sit slightly forward in chair to give an alert appearance.)

13. Be confident

14. Be courteous

    (NOTE: Words such as *Mr., Mrs., Miss, Ms., thank you, please,* and *sir* never go out of style.)

D. Answering questions clearly

1. Do not interrupt

2. Anticipate questions that might be asked and volunteer proper information

   a. Explain yes and no answers

   b. Avoid criticisms of former employers or competitors

   c. Do not talk about personal problems

   d. Show copies of your work if applicable

   e. Answer all questions honestly

   Examples: "The thing I liked least about my last job was that I was on the night shift and couldn't get changed. I really wanted to be home with my family at night."

   "Truthfully, my relationship with my supervisor could have been better. We seemed to have a personality conflict and never became fond of each other. However, we did manage to work together. This was my first experience like that and I surely hope it doesn't happen again."

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f. Give positive answers to unfavorable questions

Examples:	Interviewer: "Your work experience doesn't seem to relate specifically to this job. Why do you feel qualified to fill this position:"
	Applicant: "I understand your concern. However, my job experience is broad enough to permit me to work into this particular situation. I have done work similar to this job and I think my general work record is good enough to convince you that I would be a good employee. I would be willing to receive additional training."

g. Find a true, positive statement about your reasons for leaving previous jobs, even if you were fired

Examples:	"I was laid off, but I learned from my mistakes."
	"I left because they did not need as many employees during the slow season."

h. Try to mention your best qualities in relation to something concrete

Example:	"I earned 75 percent of my expenses while going to school" is better than "I am a hard worker and want to get ahead"

i. Be prepared for personal questions about your home life and parents' occupations

j. Avoid questions concerning politics, economics, religion, and other controversial subjects

k. Answer questions about career objectives using specific terms about what you would like to do in the near future in that particular field without limiting your opportunities

Example:	A position as a plumber that will lead to a supervisory position. No locational preference.

3. Look directly at interviewer

4. Speak in clear, moderate tones

5. Use correct English

(NOTE: Avoid swearing, slang terms, or annoying phrases like "yea," "you know," or "uh-huh.")

6. Show interest in the business; ask questions

   Example: Incorrect: "Listen, I need to know if you have any benefits."

   Incorrect: "Now that you've questioned me, there are a few things that I want to know before I decide if I want to work for you."

   Correct: "I wonder if you could give me some information about the benefits available to employees?"

7. Sell yourself

   (NOTE: Never refer to yourself as just average or fair. Always look for a positive response.)

8. Do not get flustered

9. Give the interviewer the opportunity to mention salary and fringe benefits

10. Act enthusiastically

E. Closing the interview

1. Watch for signs that the interview is over, such as the interviewer shuffling papers and moving around in chair

2. Ask "May I say one thing more?" or "Would you be interested in . . .?" if the interview seems to be ending before all important selling points have been made

3. Thank interviewer for his/her time

   Example: "I've enjoyed talking to you, Mr. Smith. Thank you for your time and consideration. I'm excited about this job and do hope I'm hired. Can you tell me when the position will be filled and how the applicants will be notified? (Answer) Please let me know if you need any additional information."

4. Learn from every situation even if the interviewer does not offer the position

F. Following up the interview--Write thank you letter, call, or visit again to express interest in the job and appreciation for the opportunity to interview

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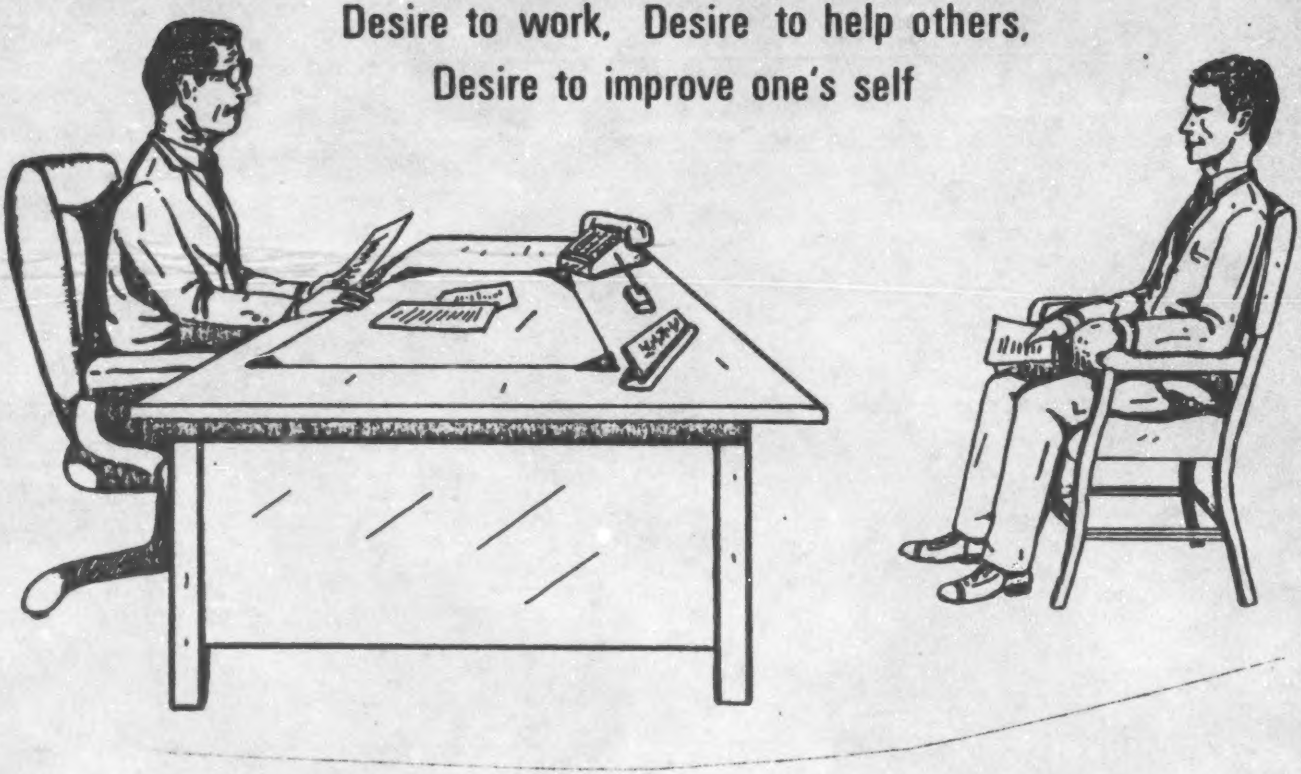
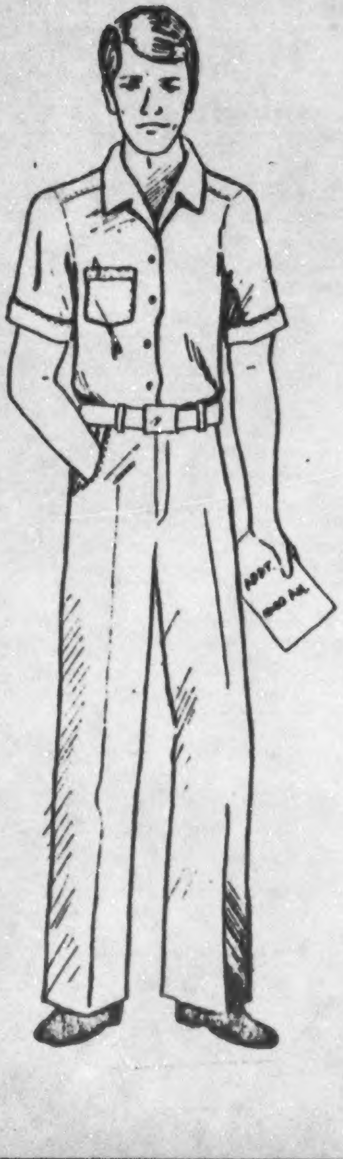
Attitudes

Enthusiasm, Interest, Dedication, Dependability,
Alertness, Quickness of mind, Honesty, Integrity,
Desire to work, Desire to help others,
Desire to improve one's self



Appropriate Dress



Hair neat?

Friendly?

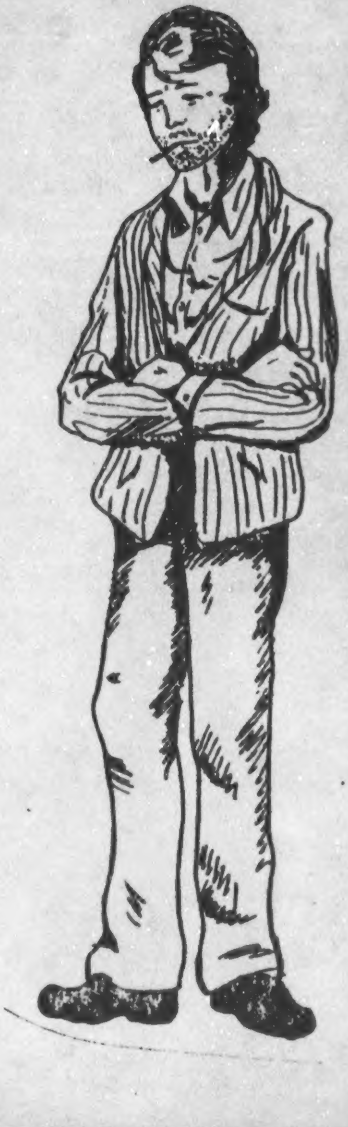
Clean Shaven?

Clean and neat clothes?

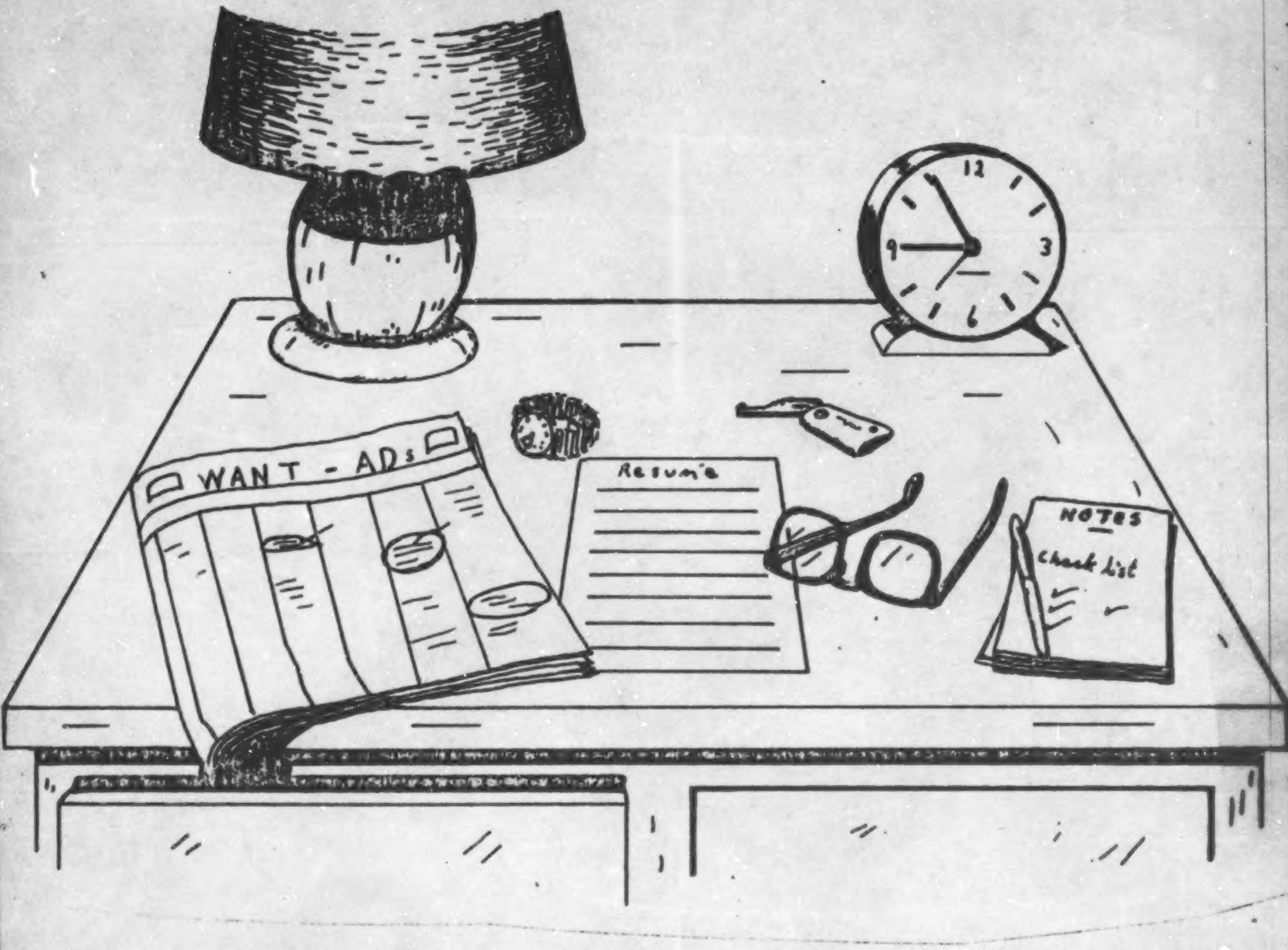
Pen and paper?

On time?

Shoes shined?



Take the Time to be on Time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3
6
9
WANT - ADs
Resumé
NOTES
Check list

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APPLYING FOR A JOB
UNIT IV

ASSIGNMENT SHEET #1–WRITE A RESUME

Write a resume using accurate facts about yourself. Include the resume with a letter of application. Use the information below and the sample resume included in this assignment sheet as guides. A good resume should immediately give prospective employers a brief summary of your accomplishments, educational background, work experience, skills, and job objective. It is not necessary to use the exact wording and outline form used on the sample resume, but it is necessary that your resume be neat and balanced and contain all the information which might help you get a job. Keep a current copy of the resume and use it to apply for jobs.

1. Inspect several resume formats and choose one that best fits your needs or use the example included in this assignment sheet as a guide.

2. Type your resume on 8 1/2 x 11 inch white paper. Try not to exceed one page but attempt to fill the page.

3. Spell correctly. Many employers will not consider persons who have resumes that include misspelled words.

4. Put your name prominently at the top in the center or upper left-hand corner. Beneath name, give full street address, city, state, zip code, telephone number with area code, and a number where messages can be accepted.

5. Do not include birthplace, age, health, height, weight, sex, marital status, photo, salary, or reasons for leaving previous job. Avoid religious and political affiliations.

   (NOTE: In general, the more information you are willing to share the better. However, the whole point of the resume is to get employers interested to meet you in person. The above information may or may not come out in the interview. By not including this information there is little or no chance for discrimination because of race, color, religion, sex, or national origin.)

6. Describe your job objective or career goal briefly. Don't restrict yourself to a specific job unless you are experienced.

7. Describe your educational background, giving dates of enrollment, diploma or degrees received, and names of schools attended. Include grade average (if favorable) and major course of study. If you include school grades, be sure they are related to the jobs you have in mind.

   (NOTE: Applicants with less than one year of work experience should list education before work experience; with more than one year, put experience first. IN RESUME WRITING, ACCENTUATE THE POSITIVE, ELIMINATE THE NEGATIVE. If pertinent, mention additonal courses, scholarships, or summer school.)

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ASSIGNMENT SHEET #1

8. List your past employment, starting with your most recent job. Carefully examine all your jobs--including extracurricular activities. CONCENTRATE ON THE SKILLS; DON'T CATEGORIZE "SUMMER JOBS."

   (NOTE: The list should include the name of the company, your job title, and your major duties. The starting and termination dates for each job should be listed. Most employers ask during interviews why you left previous jobs. Try to be positive in stating your reasons for leaving a former job. Do not downgrade your previous employers.)

9. List skills useful to the job. Remember, you have to prove your value to the business, especially if you have little experience.

   (NOTE: Use active verbs to indicate the specific tasks you performed, e.g., built, assisted, operated.)

10. Include the following information if it is relevant and if there is enough space: hobbies and interests, extracurricular activities, clubs, awards you have received.

11. Ask at least three persons for recommendations; ask yourself the kinds of recommendations they will give you

    Examples: Business references, teachers, character references

    (NOTE: Avoid listing relatives unless you have actually worked for them on a salary basis. Include some method for prospective employer to acquire references.)

12. Write "Confidential" at the top of the resume if you don't want your current employer to know you're looking for employment.

13. Have local printer retype your resume and reproduce several copies. Request white bond paper.

    (NOTE: Your resume's physical appearance is VERY IMPORTANT. Avoid using ditto or carbon copies. Be sure to proofread the printer's work. Always bring extra copies to interview. Leave one copy of resume with interviewer and use one as a reference when filling out the application form. You should also mail one resume with your letter of application.)

ASSIGNMENT SHEET #1

SAMPLE RESUME

Terry McKracken

	Present	Permanent
Address:	774 E. Adams Street Yourtown, Yourstate 77704 405-311-7779	Route #3 Anytown, Yourstate 77702 405-235-4433
	(NOTE: You may ask printer to leave space for you to fill in address if you are moving.)	

Job Objective: Career in the plumbing field leading to supervisory position in this field

Education:
Anytown High School, Anytown, Yourstate 1978-1982

Progress Vo-Tech, Progressville, Yourstate 1980
Certificate: Plumbing, four semesters
Grade average: 3.5 on a 4.0 scale

Subjects Studied:
Vocational Plumbing Class 1980-81, all phases of plumbing
Algebra--Two semesters
Geometry--Two semesters
Basic drafting--Two semesters
Industrial arts woodworking--Two semesters

Student Activities:
President, Senior Class
President, VICA
Treasurer, Baptist Youth Fellowship Organization
Plumbing contest, First Place State, Third Place National

Work Experience:
Plumber's helper, Jones Plumbing Company, Summer 1979
Vocational Plumbing Class 1978-79, all phases of plumbing
Mr. Sammy Slavedriver, Instructor

References: (with Permission)
Mr. Sammy Slavedriver
Vocational Plumbing Instructor
Progress Vo-Tech
Progressville, Yourstate 77703

Mr. John Naildriver
Plumbing Supervisor
Jones Plumbing Company
Anytown, Yourstate 77702

Mrs. Jerri Smith
Youth Director
Parkview Baptist Church
711 Fellowship Circle
Anytown, Yourstate 77702

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APPLYING FOR A JOB
UNIT IV

ASSIGNMENT SHEET #2–WRITE A LETTER OF APPLICATION FOR A PLUMBING JOB

The application letter is a sales technique to tell the employer how your abilities will be useful to the business. The letter should specify your qualifications while the resume gives general background information.

Cut a help-wanted ad for a plumbing job from the classified ad section of the local paper. Write an application letter to accompany the resume you prepared in Assignment Sheet #1. Use the following information and the sample letter as a guide.

(NOTE: If you cannot type, it is recommended that you write or print NEATLY using blue or black ink.)

1. Use acceptable form and appearance
    a. Type or write neatly
    b. Write on only one side of the paper
    c. Avoid smudges and typographical errors
    d. Use 8 1/2" x 11" white bond paper, not personal or fancy paper
    e. Spell, capitalize, and punctuate correctly
    f. Put employer's full name, title, and address
    g. Include your full name and address with zip code on the letter
    h. Retain a copy for further reference
2. Include proper information
    a. Write to a specific person

       (NOTE: Find out the name of the personnel manager/employer you want to reach and the correct title. When in doubt, write to the top person who will refer your resume to the right party. Use *To Whom It May Concern* if answering a blind ad.)
    b. Avoid excessive use of the pronoun "I"
    c. Be brief; do not repeat information in the resume
        1) State the position for which you are applying
        2) Avoid needless details

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ASSIGNMENT SHEET #2

3) Cover all points requested in the advertisement in exactly the order in which they were asked

(NOTE: Some prospective employers make it a point of testing the applicant's ability to follow directions.)

d. State reason for interest in job

(NOTE: Employers look for people who look for future advancement opportunities rather than just a paycheck.)

e. Refer briefly to the main points in the attached resume

f. Mention that persons listed on the resume have given their permission to serve as references

g. Request interview at employer's convenience

1) Tell where you can be reached

2) Enclose self-addressed envelope and resume

3) Say you will phone next week

3. Be original in your approach--Attract attention in opening paragraph

Examples:

Dear Mr. Money:

My experience as a plumber would be of interest to you.

Dear Ms. Owner:

Mr. Co-worker informed me that you are in need of a person who can be a plumber's helper. I believe that my experience and training have taught me how to handle these duties efficiently and accurately.

4. End the letter properly

(NOTE: *Sincerely yours* or *Very truly yours* is appropriate.)

5. Use permanent address for the return address and make sure to include the current date

6. Staple letter to resume as it may be circulated to several departments and otherwise become detached

ASSIGNMENT SHEET #2

7. Follow up and phone for an appointment a week later

   (NOTE: Don't be surprised if the resume has been referred to another department. Remember, they are in business and you may not get immediate attention, especially if you sent a blind letter. Be persistent until you reach the right person and ask for a convenient date to set up an interview.)

8. Keep in touch regarding possible openings now and in the future

   (NOTE: The "job hunt" may take several weeks or even months! It's important to keep your contacts alive without being a nuisance.)

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ASSIGNMENT SHEET #2

SAMPLE LETTER OF APPLICATION

Route #3
Anytown, Yourstate 77702
June 15, 1981

Mr. John Jones
Personnel Director
Jones Plumbing Company
Box 19
Yourtown, Yourstate 77704

Dear Mr. Jones:

Please consider me for the plumbing job that you advertised in the *Daily Chronicle*.

The skills I have learned in my high school vocational plumbing courses should qualify me for this job. I have had experience in all of the basic skills required by the plumbing trade, including the safe use of power tools.

I will be graduating from high school in May, and I would like to become a plumber. A more complete description of my qualifications is given in the enclosed resume.

I would appreciate the opportunity to come and talk over this job opportunity at your convenience. I can be reached by telephone at 405-235-4433 after 3:30 or at the above address.

Sincerely yours,

Terry McKracken
Encl.

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APPLYING FOR A JOB
UNIT IV

ASSIGNMENT SHEET #3–COMPLETE EMPLOYMENT APPLICATION FORM FOR A JOB AS A PLUMBER

Complete the following application form using the guidelines below. Use information corresponding to the classified ad and to your letter of application. Use information about yourself from your resume.

(NOTE: Although each business uses its own form, general rules of preparation apply to any form.)

1. Be prepared
    a. Take a good ink pen with you
    b. Take copies of resume
2. Look over entire form before starting to write; do not hurry
3. Follow directions
    a. Note whether information is to be printed or handwritten
    b. Carry out all directions
4. Write clearly, neatly, and legibly
5. Answer briefly
6. Be honest
7. Answer all questions

    (NOTE: If questions do not apply to you, write *Not Applicable* or *NA* in the space to show that you did not overlook the question.)
8. Include complete information; use resume
9. Recheck application when finished
10. Avoid cross-outs and obvious erasure marks
11. Do not list any restrictions to the geographical area in which you would work unless you absolutely will not consider other geographical areas
12. Use the word "open" for questions about minimum salary since most employers pay standardized rates and will not negotiate on this

"WE ARE AN EQUAL OPPORTUNITY EMPLOYMENT COMPANY. WE ARE DEDICATED TO A POLICY OF NON-DISCRIMINATION IN EMPLOYMENT ON ANY BASIS INCLUDING RACE, CREED, COLOR, AGE, SEX, RELIGION OR NATIONAL ORIGIN OR PHYSICAL DEFECTS."

APPLICATION FOR EMPLOYMENT

LAST

FIRST

MIDDLE

PERSONAL INFORMATION

DATE

NAME
LAST FIRST MIDDLE

PRESENT ADDRESS
STREET CITY STATE ZIP

PERMANENT ADDRESS
STREET CITY STATE ZIP

PHONE NO. SOCIAL SECURITY NUMBER

REFERRED BY

EMPLOYMENT DESIRED

POSITION DATE YOU CAN START SALARY DESIRED

ARE YOU EMPLOYED NOW? IF SO, MAY WE INQUIRE OF YOUR PRESENT EMPLOYER

EVER APPLIED TO THIS COMPANY BEFORE? WHERE WHEN

EDUCATION	NAME AND LOCATION OF SCHOOL	YEARS ATTENDED	DATE GRADUATED	SUBJECTS STUDIED
GRAMMAR SCHOOL				
HIGH SCHOOL				
COLLEGE				
TRADE, BUSINESS, OR CORRESPONDENCE SCHOOL				

SUBJECTS OF SPECIAL STUDY OR RESEARCH WORK

U.S. MILITARY OR NAVAL SERVICE RANK PRESENT MEMBERSHIP IN NATIONAL GUARD OR RESERVES

ACTIVITIES OTHER THAN RELIGIOUS (CIVIC, ATHLETIC, FRATERNAL, ETC.)

Exclude organizations, the name or character of which indicates the race, creed, color, or national origin of its members.

(CONTINUED ON OTHER SIDE)

FORMER EMPLOYERS (LIST BELOW LAST FOUR EMPLOYERS, STARTING WITH LAST ONE FIRST.)

DATE MONTH & YEAR	NAME AND ADDRESS OF EMPLOYER	SALARY	POSITION	REASON FOR LEAVING
FROM TO				
FROM TO				
FROM TO				
FROM TO				

REFERENCES: Give below the names of two persons not related to you, whom you have known at least one year.

NAME	ADDRESS	BUSINESS	YEARS ACQUAINTED
1			
2			

PHYSICAL RECORD:
List any physical defects

WERE YOU EVER INJURED? GIVE DETAILS

HAVE YOU ANY DEFECTS IN HEARING? IN VISION? IN SPEECH?

IN CASE OF EMERGENCY NOTIFY
NAME ADDRESS PHONE NO.

I AUTHORIZE INVESTIGATION OF ALL STATEMENTS CONTAINED IN THIS APPLICATION. I UNDERSTAND THAT MISREPRESENTATION OR OMISSION OF FACTS CALLED FOR IS CAUSE FOR DISMISSAL. FURTHER, I UNDERSTAND AND AGREE THAT MY EMPLOYMENT IS FOR NO DEFINITE PERIOD AND MAY, REGARDLESS OF THE DATE OF PAYMENT OF MY WAGES AND SALARY, BE TERMINATED AT ANY TIME WITHOUT ANY PREVIOUS NOTICE.

DATE SIGNATURE

DO NOT WRITE BELOW THIS LINE

TO BE COMPLETED DAY EMPLOYMENT BEGINS

DATE

HEIGHT WEIGHT AGE DATE OF BIRTH

SINGLE MARRIED WIDOWED CITIZEN U.S.A. SEX

THE ABOVE INFORMATION NEEDED FOR PENSION, HOSPITALIZATION, INSURANCE, ETC., AND NOT FOR HIRING PURPOSES

INTERVIEWED BY DATE REMARKS

NEATNESS		CHARACTER	
PERSONALITY		ABILITY	

HIRED FOR DEPT. POSITION WILL REPORT SALARY WAGES

APPROVED: 1. 2. 3.
EMPLOYMENT MANAGER DEPT. HEAD GENERAL MANAGER

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ASSIGNMENT SHEET #4--PRACTICE INTERVIEW QUESTIONS

The following are some additional questions which might be asked when applying for various jobs. Keep the assignment sheet to review before going on any actual interview.

(NOTE: Questions about your personal life may not legally be asked. In fact, it is illegal for an employer to ask your maiden name or your father's surname if you are a female applicant; your marital status; who lives with you; the church you attend or the name of your spiritual leader; how many children you have, their ages, or who will care for them while you are at work; whether you own or rent your residence; whether you have ever had your wages garnisheed; and whether you have ever been arrested. However, many interviewers, particularly in smaller businesses, may ask such questions. Whether or not you chose to answer the questions depends on how badly you want the job.)

How would you answer the following questions? Why do you think each question might be asked?

1. Where do you go to school? When will you graduate?
2. Do you (did you) earn any of your own expense money while in school?
3. Why did you leave your previous job(s)?
4. What did you like best and what did you like least about your classes?

   (NOTE: This could be asked about teachers, jobs, or employers.)
5. What books have you read lately? What are your favorite magazines?
6. Are you in good health?
7. What do you expect to be doing five or ten years from now? What is your chosen field of work?
8. At what salary do you expect to start?
9. What are some of your special abilities? What skills do you possess? What tools or equipment can you operate?
10. How would you rate your training for this job? Very good? Fair?
11. What personal characteristics do you think are needed to succeed in your vocation?

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ASSIGNMENT SHEET #4

12. In what area do you need the most improvement?

13. Do you like to work with other people or do you work best alone?

14. Do you have any questions you want to ask us?

15. Do you think your extracurricular activities were worth the time you devoted to them?

16. How could you contribute to our organization? Why should we hire you?

17. Tell us about your family and any plans for marriage or further education.

    (NOTE: REMEMBER: Legally, you do not have to answer this question. However, it is a good idea to prepare an answer in case such a question is asked.)

18. For what other jobs have you applied?

19. Do you have any military obligations to fulfill?

20. Give us an example of a project you finished under pressure.

21. May we write or call your last employer?

22. How many people have you supervised at work or through organizations of which you are a member?

23. How do you feel about the progress you have made salary-wise?

24. Would you be able to work all day Saturday and Sunday?

25. If you could start school (or work) over again what would you do differently?

26. What is your school attendance record?

27. Have you done the best school work of which you are capable?

28. Do you require attention? Does criticism disturb you?

    (NOTE: These questions are usually asked in a more subtle and indirect way.)

29. What motivates you?

30. Would you be willing to relocate?

31. What size city do you prefer?

ASSIGNMENT SHEET #4

32. Have you saved any money?

33. Define *cooperation*.

34. What job with our company would you choose if you were entirely free to do so?

35. How do you feel about working overtime?

REMEMBER: YOU NEVER GET A SECOND CHANCE TO MAKE A GOOD FIRST IMPRESSION!!! GETTING A JOB IS A JOB!!!

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ASSIGNMENT SHEET #5–MAKE AN APPOINTMENT BY PHONE FOR A PLUMBING JOB INTERVIEW

Making an appointment by phone does two things. First, it shows that you are interested in saving the employer's time. Second, it shows that you are thoughtful for asking what would be the best time for you to see the employer.

1. Steps in making an appointment by phone
   a. Plan what you are going to say before you call
   b. State your name and reason for calling

      Example: "Hello, this is Terry McKracken. I'm calling about your ad in last night's paper for a plumber. May I have an appointment for an interview?"

   c. Ask when would be the best time for you to come for the interview
   d. Record the day, time, and place of the interview
   e. Thank the receptionist for the help
2. Things to remember when calling for an appointment
   a. Keep the receptionist on your side; the receptionist is there to help you

      (NOTE: The receptionist is sometimes asked to evaluate the applicant.)

   b. Do not ask over the phone how much the job pays
   c. Be polite and courteous

      (NOTE: Remember that this call is the first contact you may have with the firm. Make that first impression a good one.)

   d. Ask if you should pick up an application blank or if they would like to send it to you before the interview

Now that you have read about the correct way to arrange for a job interview, role play a situation where you make an appointment by phone. Use the checklist on the next page to evaluate your performance.

ASSIGNMENT SHEET #5

	YES	NO
Was prepared before calling		
Did not have to stammer to find the right words		
Identified self immediately		
Stated reasons for calling immediately		
Asked the best time for an appointment with employer		
Was courteous and friendly		
Asked about picking up application blank or having application blank sent prior to interview		
Thanked the receptionist		
Made record of the interview date, hour, and place		

APPLYING FOR A JOB
UNIT IV

ASSIGNMENT SHEET #6--WRITE A FOLLOW-UP LETTER OR MAKE A FOLLOW-UP PHONE CALL AFTER INTERVIEW FOR PLUMBING JOB

It is sometimes helpful to return to a business and check again on possible job openings. This is often done about a week after the first interview. This short casual visit accomplishes two things. It helps the interviewer remember you, and it shows that you have a sincere interest in working for that company.

However, it is not always possible to have this type of informal atmosphere when applying for a job. In which case, it is always proper to send a follow-up letter or make a follow-up telephone call.

PART A

Write a follow-up letter thanking the employer for the interview. Use any form you wish or follow the format of the sample follow-up letter included in the assignment sheet.

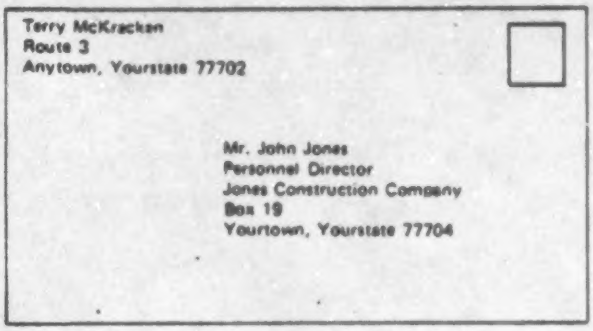
1. Make sure your letter meets the following standards
    - a. Typed or written perfectly
    - b. Clean, neat, and attractively arranged on the page
    - c. Free from spelling, punctuation, and grammatical errors
    - d. Sent within a day or two after the interview
2. Include the following points in your follow-up letter
    - a. Expression of appreciation for interviewer's time and interest
    - b. Summary of your qualifications and interest in position
    - c. Your name, address, and phone number (to make it easier for your employer to contact you)
3. Make this last bid for the job a prime example of your excellent work habits; make the letter clean, neat, and well-worded

ASSIGNMENT SHEET #6

4. Address a legal-sized envelope (Figure 1)

   (NOTE: Be sure and type the address EXACTLY the same as the inside address of the letter.)

FIGURE 1



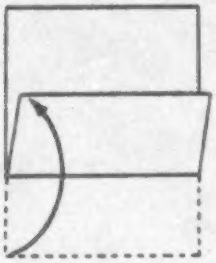
Terry McKracken
Route 3
Anytown, Yourstate 77702

Mr. John Jones
Personnel Director
Jones Construction Company
Box 19
Yourtown, Yourstate 77704

5. Fold letter

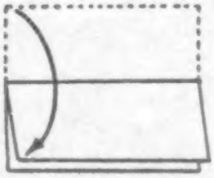
   a. Fold slightly less than one-third of the letter toward the top (Figure 2)

FIGURE 2



   b. Fold down the top of the letter to within 1 cm (1/2") of the bottom fold (Figure 3)

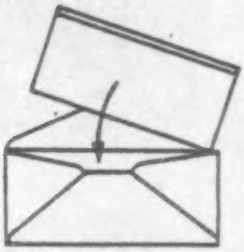
FIGURE 3



ASSIGNMENT SHEET #6

6. Insert the letter into the envelope with the last crease toward the bottom of the envelope (Figure 4)

FIGURE 4



PART B

Role play a follow-up telephone call using the guidelines below.

1. Make sure you include the following information
   a. Your name
   b. Date of your interview
   c. Position for which you were interviewed
2. Ask whether a decision has been made

Example:	Incorrect:	"Hello, Mr. Jones. This is Terry McKracken. You told me you would let me know about the job, but I haven't heard anything from you. Why haven't you called me?"
	Incorrect:	"This is Terry McKracken. Did I get the job?"
	Correct:	"Hello, Mr. Jones. This is Terry McKracken. I interviewed with you on June 30th for the position of a plumber. Have you made a decision on my application yet?"

ASSIGNMENT SHEET #6

3. If someone has already been hired, thank the interviewer for considering you but express continued interest in working for the company

Example:	Incorrect:	"Oh well, that's my luck. Thanks anyway."
	Incorrect:	"I didn't want to work for your company anyway."
	Correct:	"I am sorry I was not hired. Thank you for at least considering my application. I am still interested in working for the company and would appreciate you keeping my application on file."

ASSIGNMENT SHEET #6

SAMPLE FOLLOW-UP LETTER

Route #3
Anytown, Yourstate 77702
July 1, 1980

Mr. John Jones
Personnel Director
Jones Plumbing Company
Box 19
Yourtown, Yourstate 77704

Dear Mr. Jones:

Thank you for interviewing me for the job of rough framing carpenter with your company. I feel that working for Jones Plumbing Company would be enjoyable and that I could do the general plumbing work that the job requires. I hope that I will have the opportunity to prove my worth.

The application form you gave me is enclosed.

I will be available for work May 15. You may call me at my home after 3:30 p.m. The number 405-235-4433.

Sincerely yours,

Terry McKracken

Encl.

F-91-

ASSIGNMENT SHEET #7–EVALUATE A PLUMBING JOB OFFER

Instead of saying "yes" or "no" on the spot to a job offer, express your gratitude in a warm and friendly manner, and then ask if you may have time to consider the opportunity you have been offered. Few reputable employers will deny you a reasonable time to be certain before agreeing to take a job.

Avoid getting stuck with a job that's wrong for you by using the following checklist to evaluate the job offer.

THE JOB . . .

Do I clearly understand the nature of the work and is it what I want to do? Are my responsibilities reflected in the job title?

If this isn't my dream job, can it be a stepping stone as I acquire the skills and experience needed for advancement?

Is the background I'm building so narrow that I will have difficulty transferring it to another employer?

Will I be able to make any decisions affecting my work? Do I care?

Will I need more training and will the company pay for it?

Will overtime be necessary or available?

Will I be able to leave all thought of the job behind at day's end? If not, do I care?

Will I have to travel or relocate?

Is the job permanent or temporary?

If permanent, is there reasonable job security?

Does this job require union membership?

THE COMPANY . . .

Is the firm too large and heavy with rules for my personality?

Is the firm too small to offer room for advancement or impressive credentials for a future resume?

ASSIGNMENT SHEET #7

Does the firm have a healthy financial position and is it a growing organization?

Is there a high turnover of personnel, and if so, why?

Does the firm promote from within the ranks or turn to outsiders to fill supervisory jobs?

Have I met the person who would be my immediate supervisor?

Does the supervisor seem like the sort of person with whom I could get along?

Do co-workers appear to be my kind of people?

Is the company's location convenient?

What is the firm's reputation for fair treatment of employees?

Is a written personnel statement available that covers vacations, sick leave, cause for dismissal, and so forth?

FINANCIAL REWARDS . . .

Do the earnings meet my minimum needs? Are there automatic cost-of-living increases?

What is the method of payment--salary, hourly wage?

Are raises based on merit, length of service, formal exams?

What fringe benefits are given--health insurance, free parking, discount privileges, and others?

WHEN TO SAY NO . . . Should you always turn down an offer that doesn't measure up?

That depends on several questions. How desperately do you need to earn money? How competitive is the field you hope to enter, and would it be best to get your foot in the door any way you can? How valuable is the experience you'll gain? There are times when it is wise to accept a job which is not perfect in your eyes.

On the other hand, it could be best to refuse the offer.

Adapted from "If Things Don't Shape Up, I May Not Take the Job," Career World, February, 1977.

APPLYING FOR A JOB
UNIT IV

ASSIGNMENT SHEET #8--COMPARE JOB OPPORTUNITIES

When you are offered a job or are changing jobs there are many factors to weigh before taking the position. Some of these include:

- What is your take-home pay?
- What are the benefits which accompany the job?
- How much will it cost to actually be at work each day?
- Would the job be satisfying to you?
- How would the job meet your needs and aspirations?

WHAT'S MY TAKE-HOME PAY?

Salaries and wages are often quoted by employers as gross earnings. Gross earnings are used because tax deductions vary due to the number of dependents, the amount of earnings, and other information.

Optional benefits and deductions offered by an employer also differ. It is generally advisable to ask what programs are available for enrollment as these can affect the actual money you receive on pay day.

ASSIGNMENT SHEET #8

WHAT OTHER BENEFITS DO I GET FROM THIS JOB?

Some benefits associated with working are not always visible. Often some of these overlooked benefits are paid for in part by your employer. At the time of the interview or when considering a positon ask about:

- Employer's contributions for your protection which may include:
    - Health insurance
    - Unemployment compensation
    - Clothing and safety garments
    - Medical facilities and health tests
    - Pensions
    - Travel insurance (covering mishaps when traveling on business)
    - Educational programs or reimbursement for courses related to job
- Sick leave with pay
- Paid vacations and holidays

WHAT WILL IT COST TO WORK AT THIS JOB?

Frequently, we often overlook the costs which are associated with being employed. It may be of value to calculate estimated weekly expenses before you make a decision about a job.

Estimate weekly expenses for:

Transportation (parking, bus fares) $______

Lunches (or cost of food eaten away from home, including soft drinks and coffee $______

Clothing (including cleaning $______

Child care for working parent $______

Gifts for other employees $______

Special uniforms, materials, or equipment for job $______

Other $______

TOTAL $______

ASSIGNMENT SHEET #8

WHAT IS IMPORTANT TO ME IN A JOB?

Take-home pay and benefits may be only part of what you want from a job. Think through other things you consider important in a job.

What are some of the most rewarding things you've felt about any job you've ever had?

1. ____
2. ____
3. ____

How might you rate these in order of what's important to you?

_____ Job security (little chance you'll be released from the job)

_____ Opportunity for advancement

_____ Recognition for your work

_____ Good wages

_____ Opportunity to learn and use your ideas

_____ Flexible working hours

_____ Long vacations

_____ Pleasant working conditions

_____ Interesting work

_____ Friendly co-workers

_____ Other, such as ______________________________

ARE YOU READY TO DECIDE????

Take all the information you have gathered and summarize it below and on the next page to reach a decision about whether you want the job or not.

1. Would the job be satisfying to you? Why/why not?

____

____

____

ASSIGNMENT SHEET #8

2. What are the benefits which accompany the job?

3. How much will it cost to actually be at work each day?

4. How would the job meet your needs and aspirations?

5. I estimate my take-home pay to be $__________.

6. I estimate my expenses related to working to be $__________.

7. I would most enjoy the following about this job: __________

8. I estimate my job benefits to be worth $ __________.

APPLYING FOR A JOB
UNIT IV

NAME ______________________

TEST

1. Match the terms on the right to the correct definitions.

_____a. Brief, typed summary of one's qualifications and experience that is used in applying for a job

_____b. Extras provided by an employer, such as paid vacations, sick leave, and insurance protection

_____c. Recognition received for outstanding achievement

_____d. Experience, education, and physical characteristics which suit a person to a job

_____e. Any vocational courses and skills one has learned in high school or through work experience

_____f. Clubs, organizations, and social or church groups in which one participates

_____g. To attach wages or other property to satisfy a debt

_____h. Meeting of employer and job applicant for purpose of evaluation and questioning

_____i. Printed form on which job applicants record information about their personal history, job history, job experience, education, and references

_____j. Business that is designed to help individuals find employment

_____k. Classified advertising that does not identify the advertiser

_____l. Classified advertisement placed by individuals seeking employment and telling what their qualifications are

1. Award
2. Interview
3. Extracurricular activities
4. Fringe benefits
5. Application form
6. Qualifications
7. Resume
8. Garnishee
9. Vocational preparation
10. Employment agency
11. Equal opportunity employer
12. Blind ad
13. Help wanted ad
14. Legible
15. Employment/situation wanted ad

_____m. Classified advertisement telling what kind of job is available and what the qualifications are

_____n. Capable of being read; clear

_____o. Employer who is making a special effort to assure that no form of discrimination is practiced

2. List four means of locating job openings.

a.

b.

c.

d.

3. List three methods of applying for a job.

a.

b.

c.

4. Select personal attributes or attitudes an employer looks for during a personal interview by placing an "X" in the appropriate blanks.

_____a. Alertness, quickness of mind

_____b. Long wavy hair

_____c. Dedication and dependability

_____d. Enthusiasm and interest

_____e. New car

_____f. Honesty and integrity

_____g. Desire to work

_____h. Beard

_____i. Flashy clothes

_____j. Desire to help others

_____k. Desire to improve one's self

*5. Select guidelines for dressing for an interview by placing an "X" in the appropriate blanks.

_____a. Kind of job

_____b. Salary range

_____c. What employer is wearing on the job

_____d. Age of the interviewer

_____e. Age of the interviewee

_____f. Wear highly fashionable clothing

_____g. Be modest and well-groomed

6. List four items which an applicant may need to prepare when applying for a job.

a.

b.

c.

d.

7. Select guidelines to follow when participating in a job interview by placing an "X" in the appropriate blanks.

_____a. Take parents or friends with you to job interview

_____b. Know facts about the business

_____c. Start the interview with a smile and greet the interviewer by name

_____d. Place personal things, such as coat, hat, or purse, on interviewer's desk

_____e. Criticize former employers or competitors when applicable

_____f. State that you are willing to start at the beginning salary

_____g. Answer all questions honestly

_____h. Ask questions about politics, economics, religion, and other controversial subjects

_____i. Look directly at interviewer

_____j. Do not ask questions or show interest in the business _____k. Thank interviewer for his/her time

_____l. Write thank you letter, call, or visit again to express interest in the job and appreciation for the opportunity to interview

8. Write a resume.
9. Write a letter of application for a plumbing job.
10. Complete employment application form for a job as a plumber.
11. Practice interview questions.
12. Make an appointment by phone for a plumbing job interview.
13. Write a follow-up letter or make a follow-up phone call after interviewing for a plumbing job.
14. Evaluate a plumbing job offer.
15. Compare job opportunities.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

BASIC HAND TOOLS
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify the basic hand tools used in the plumbing trade. The student should also be able to demonstrate the proper use and care of these tools. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with basic hand tools to the correct definitions or descriptions.
2. Identify the basic hand tools.
3. Select the appropriate tool from similar groups.
4. Discuss the proper care of hand tools.
5. Demonstrate the ability to:
    a. Measure lines to the nearest quarter, eighth, and sixteenth of an inch.
    b. Read a rule/tape measure.
    c. Use hand tools to inspect/replace a washer on a globe valve.
    d. Measure and mark a predetermined length on a pipe.
    e. Use hand tools to cut a length of steel pipe.
    f. Use hand tools to ream steel pipe.
    g. Use hand tools to cut pipe threads.
    h. Set up and use a hacksaw.

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BASIC HAND TOOLS
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide student with objective sheet.

  B. Provide student with information, assignment, and job sheets.

  C. Make transparencies.

  D. Discuss unit and specific objectives.

  E. Discuss information and assignment sheets.

  F. Demonstrate and discuss the procedures outlined in the job sheets.

  G. Conduct shop tour of tool crib/tool storage areas.

  H. Give test.

II. Student:

  A. Read objective sheet.

  B. Study information sheet.

  C. Complete assignment and job sheets.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM 1--Screwdrivers

    2. TM 2--Wrenches

    3. TM 3--Pliers

    4. TM 4--Hammers

    5. TM 5--Punches, Chisels, and Bars

P-3-

6. TM 6--Files
7. TM 7--Socket Sets
8. TM 8--Tubing Tools
9. TM 9--Tools for Cutting and Threading Iron Pipe
10. TM 10--Accessory Hand Tools
11. TM 11--Threading Tools
12. TM 12--Graduations on a Rule
13. TM 13--Reading the Eighths Rule
14. TM 14--Reading the Sixteenths Rule

D. Assignment Sheets

1. Assignment Sheet #1--Measure Lines to the Nearest Quarter, Eighth and Sixteenth of an Inch
2. Assignment Sheet #2--Read a Rule/Tape Measure

E. Answers to assignment sheets

F. Job sheets

1. Job Sheet #1--Use Hand Tools to Inspect/Replace Washer on a Globe Valve
2. Job Sheet #2--Measure and Mark a Predetermined Length on a Pipe
3. Job Sheet #3--Use Hand Tools to Cut Steel Pipe with a Pipe Cutter
4. Job Sheet #4--Use Hand Tools to Ream Steel Pipe
5. Job Sheet #5--Use Hand Tools to Cut Pipe Threads
6. Job Sheet #6--Set Up and Use a Hacksaw

G. Test

H. Answers to test

II. References:

A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, Ill.: Goodheart-Willcox Company, 1978.

B. Bureau of Naval Personnel. *Tools and Their Uses.* Washington, D.C.: United States Government Printing Office, 1971.

4-B

BASIC HAND TOOLS
UNIT I

INFORMATION SHEET

I. Terms and definitions

   A. Hand tool--Tool which is hand held and is not electrical or specialized

      (NOTE: The majority of work done in residential plumbing is done with hand tools.)

   B. Specialized tool--Tool designed for a particular use

   C. Plumber's tool box--Personalized tool kit containing the basic hand tools

   D. Pipe cutters--Plumber's tools used for cutting pipe

   E. Pipe wrenches--Tools used to turn threaded pipe and fittings, made in a variety of sizes and shapes

   F. Threading--Method of developing spiral cuts on pipe in order to facilitate joining

   G. Male/female--Designates joints of pipe in reference to the fitting; female receives the male pipe

   H. Pipe thread--A special thread designed for piping systems; does not fit objects with machine threads

   I. Safety--The condition of being safe from undergoing or causing hurt, injury, or loss

      (NOTE: Plumbers usually purchase their own hand tools, therefore, one must develop a special responsibility towards tool care.)

II. Basic hand tools

   A. Screwdrivers (Transparency 1)

      1. Standard slot
      2. Phillips
      3. Clutch head
      4. Stubby
      5. Offset
      6. Reed and Prince

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LP

INFORMATION SHEET

B. Wrenches (Transparency 2)

   1. Open end
   2. Box end
   3. Combination
   4. Adjustable open end
   5. Pipe
   6. Flare nut

C. Pliers (Transparency 3)

   1. Slip joint
   2. Slip groove
   3. Long nose
   4. Diagonal cutters
   5. Plier wrench
   6. Pinch-off

D. Hammers (Transparency 4)

   1. Ball peen
   2. Soft face
   3. Long handle sledge
   4. Straight claw

E. Punches, chisels, and bars (Transparency 5)

   1. Pin punch
   2. Center punch
   3. Flat chisel (cold chisel)
   4. Pry bar
   5. Scratch awl
   6. Wood chisel

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RP

INFORMATION SHEET

7. Flooring chisel
8. Bullnose chisel

F. Files (Transparency 6)

1. Flat
2. Half round
3. Round
4. Point
5. Triangular
6. Handle

G. Sockets sets (Transparency 7)

1. Ratchet handle
2. Socket
3. Deep socket
4. Hinge handle (break-arm)
5. Extension
6. Speed handle
7. Universal joint

H. Tubing tools (Transparency 8)

1. Flaring tool
2. Tubing reamer
3. Flaring block
4. Cutter
5. Swage punch
6. Lever type bender
7. Bending spring
8. Geared ratchet-type bender

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INFORMATION SHEET

I. Iron pipe tools (Transparency 9)

  1. Pipe vise
  2. Dies and die head
  3. Pipe reamer
  4. Pipe cutter

J. Accessory hand tools (Transparency 10)

  1. Drop light
  2. Hacksaw
  3. Safety glasses
  4. Nut drivers
  5. Level
  6. Hex key wrenches
  7. Basin wrench
  8. Cuttng oil
  9. Lubricating oil

K. Threading tools (Transparency 11)

  1. Tap
  2. Stock and dies
  3. Die stock
  4. T-Handle tap wrench
  5. Three-way pipe die

III. Hand tool use

A. Screwdrivers

  1. Standard slot--For tightening or loosening bolts and screws with a slot type head.
  2. Phillips--For tightening or loosening bolts and screws with a phillips type head

     (NOTE: Use proper size to prevent rounding out screw slots.)

3. Clutch head--For tightening or loosening a clutch head bolt or screw

   (NOTE: The blade must fit the screw slot in order to function properly.)

4. Stubby--For working in close places where a longer blade would not fit

5. Offset--For working in extremely close places

B. Wrenches

1. Open end--For tightening or loosening hex head bolts, nuts, or screws

2. Box end--For tightening or loosening hex head bolts, nuts, or screws, but is less likely to slip off

3. Combination--Box and open end for tightening or loosening hex head bolts, nuts, or screws

   (NOTE: This wrench has both an open end and a box end and it enables you to carry a fewer number of wrenches.)

4. Adjustable open end--For tightening or loosening various sizes of nuts and bolts

5. Pipe--Primarily for tightening or loosening round pipe or other rounded surfaces

   (NOTE: This wrench will adjust to fit various size surfaces and it also has teeth to prevent slipping.)

6. Flare nut--For tightening or loosening a flare nut; it has a box end with a notch cut out so that it can be slipped over the tubing

C. Pliers

1. Slip joint--For holding or turning a part where marring of the surface is not a problem

2. Slip groove--For the same purpose as slip joint pliers, but the jaws will generally open wider and the handles provide more leverage

3. Long nose--For holding or reaching small items

4. Diagonal cutters--For cutting wire

   (NOTE: These should not be used for tin snips.)

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INFORMATION SHEET

5. Plier wrench--For an excessively tight grip; it has a locking lever to prevent slipping

   (NOTE: These are commonly referred to as vise-grips.)

D. Hammers

   1. Ball peen--For hammering on metal tools such as punches and chisels
   2. Soft face--For hammering on or driving materials that a steel face hammer would mar or break

      (NOTE: Soft face hammer faces are made of plastic, rubber, rawhide, copper, lead, or wood.)

   3. Sledge--For breaking and pounding; it is heavy, long handled, and has a steel face
   4. Claw--Generally for driving and pulling nails

E. Punches, chisels, and bars

   1. Pin punch--For driving both straight and tapered pins in or out of hubs and shafts
   2. Center punch--For making identations in metal for starting a drill
   3. Flat chisel--For cutting off bolt heads or splitting nuts

      (NOTE: A flat chisel is sometimes referred to as a cold chisel.)

   4. Pry bar--Generally for jobs that require prying an object into alignment
   5. Scratch awl--Generally for scratching a line on metal, making screw holes in sheet metal, and for aligning screw holes
   6. Wood chisel--Used to cut notches and holes in wood structure for pipes
   7. Flooring chisel--Used to cut lead ingots for melting

      (NOTE: Molten lead is used for caulking iron pipe joints)

   8. Bullnose chisel--Used for chipping or breaking holes in concrete

F. Files

   1. Flat--For smoothing metal surfaces; it is a double cut file
   2. Half round--For filing rounded surfaces on metals

3. Round--Generally for enlarging holes in metal

   (NOTE: Round files taper to a point and are sometimes referred to as "rat-tail" files.)

4. Point--For filing contact points; it is a small, thin file

5. Triangular--Generally for cleaning up damaged threads

   (NOTE: Slim taper files are sometimes called saw files.)

6. File handle--Wooden handle placed on the end of the file to prevent it from gouging one's hand

G. Socket sets

(NOTE: Socket sets are made in 1/4" and 1/2" for light and heavy jobs.)

1. Ratchet--Permits tightening or loosening with very little swinging room; it is a drive handle that sockets fit onto

2. Socket--For tightening or loosening a hex head bolt or nut; used in conjunction with a drive handle

3. Deep socket--Socket with an extended wall for reaching recessed bolts and nuts or nuts that have the bolt extending through them so far that the standard socket will not fit over them

4. Hinge handle--Drive handle that is used with sockets when more force is needed to break loose or tighten a nut or bolt

   (NOTE: These handles are sometimes called break-overs.)

5. Extension--Rod that fits between the socket and the drive handle to extend the socket into hard to reach places

6. Speed handle--Drive handle used with a socket to tighten or loosen bolts and nuts quickly that are easy to reach

7. Universal joint--Fits between the drive handle and the socket and bends in any direction enabling the socket to get to hard to reach nuts or bolts

H. Tubing tools

1. Flaring tool--For forcing a 45° cone into the end of a piece of tubing being held by a flaring block which creates a flare on the tubing

2. Tubing reamer--For removing the burr from the inside of tubing after it has been cut

   (NOTE: This is usually attached to the tubing cutter.)

3. Flare block--For holding the tubing while it is being flared or swaged

4. Tubing cutter--For cutting the tubing by tightening it onto the tubing and rotating it at the same time

   (NOTE: These come in large, medium, and small sizes.)

5. Swage punch--Driven into the end of a tube to enlarge it so that another tube of the same size may be placed in it and soldered

   (NOTE: Swage punches are made in various sizes: 1/2", 3/4", 1".)

6. Lever-type bender--Tubing is held securely against the bender and the arm is slid over the tubing forcing the tubing into the rounded end of the bender

7. Bending spring--Coil spring which is placed on the outside of tubing to keep it from collapsing while bending

I. Accessory hand tools

1. Drop light--For light in dark work areas; it has a protective reflective shield and an electrical outlet in the handle

   (NOTE: These lights usually have 25 ft. or longer cord and should not be used as power cords for high amperage appliances, such as pipe threading machines because they are made of small gauge wire.)

2. Handsaw--Small saws used for notching access holes and also for cutting plastic pipe

3. Oil can--Should have a flexible spout for reaching difficult places and a cap to prevent spillage

4. Hacksaw--For cutting metals

   (CAUTION: A hacksaw is not recommended for cutting pipe and tubing; use tubing cutters and pipe cutters.)

5. Safety glasses--Eye protection that should be worn on all jobs

6. Level--For checking the levelness of fixtures and the pitch of pipe

   (NOTE: Two kinds of levels are the small bubble level and the torpedo level.)

7. Hex key wrenches--For loosening or tightening socket type set screws in English and metric sizes

   (NOTE: Hex key wrenches are often used in faucet repair.)

J. Threading tools

1. Taps--For cutting threads inside of hole

   (NOTE: These are available in all types and sizes of threads.)

2. Dies--For cutting external threads on pipe

   (NOTE: These are available in all types and sizes of threads.)

3. Handles--For holding taps and dies during the threading process

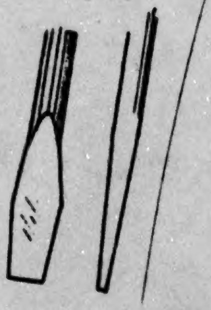
   (NOTE: These include T-handles and hand tap wrenches that hold taps and die stocks for holding dies.)

IV. Hand tool care

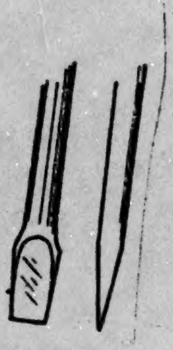
A. Screwdrivers

1. Grind flat tip square

Ground Right

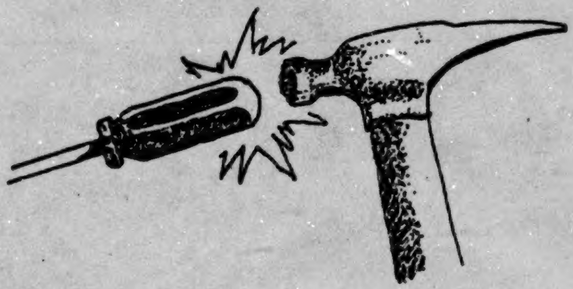


Ground Wrong



2. Discard worn phillips tips

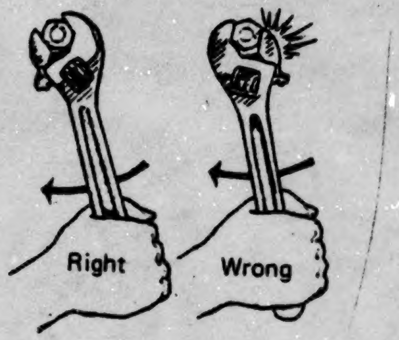
3. Do not hammer on screwdrivers



INFORMATION SHEET

B. Wrenches

1. Turn adjustables in proper direction

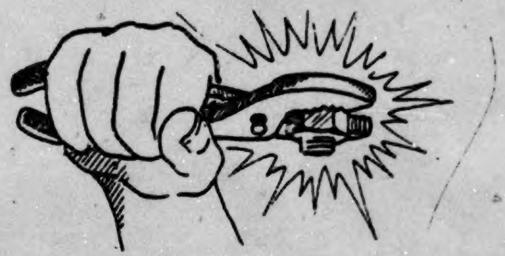


2. Do not hammer on wrenches

3. Do not hammer with wrenches

C. Pliers

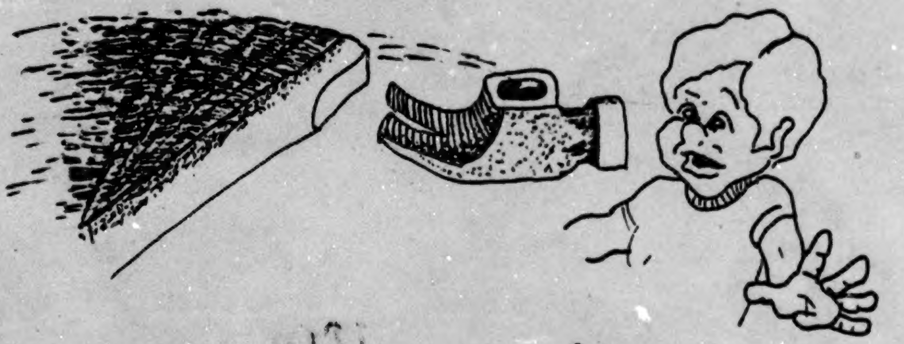
1. Do not use in place of wrench



2. Have handles insulated when working on electrical circuits

D. Hammers

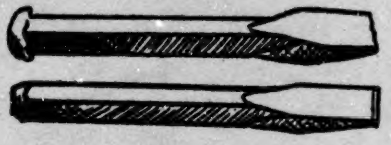
1. Keep handles tight



2. Use the proper type hammer for the job

E. Punches, chisels, and bars

1. Keep cutting edges and points sharp



Before and After Dressing

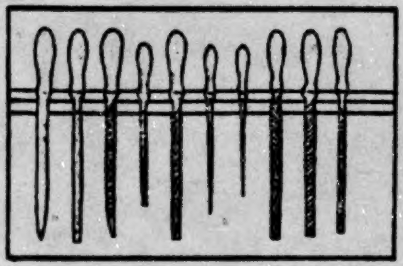
(NOTE: Do not overheat chisel points.)

2. Keep head ground to prevent mushrooming

F. Files

1. Keep files on a wall rack

(NOTE: They will become dull if stacked in a drawer.)



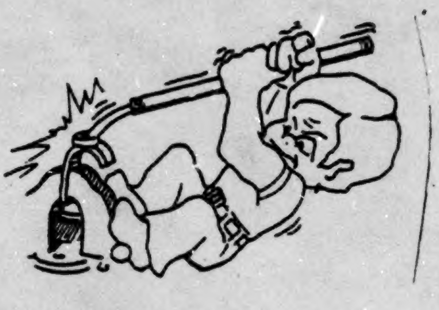
2. Do not hammer or pry with a file

(NOTE: They are very brittle and will break.)

G. Socket sets

1. Do not use an extension pipe or cheater bar on the handle of a ratchet

   (NOTE: Too much force will strip the gears in the ratcheting mechanism.)



2. Do not use a handle and extension pipe with thin wall sockets

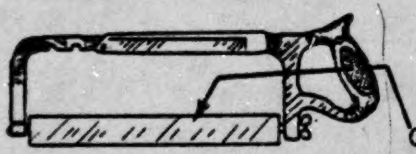
   (NOTE: Thin wall sockets will break.)

H. Tubing tools

1. Oil threads on flaring tool
2. Replace cutting wheel on cutter when dull

I. Accessory hand tools

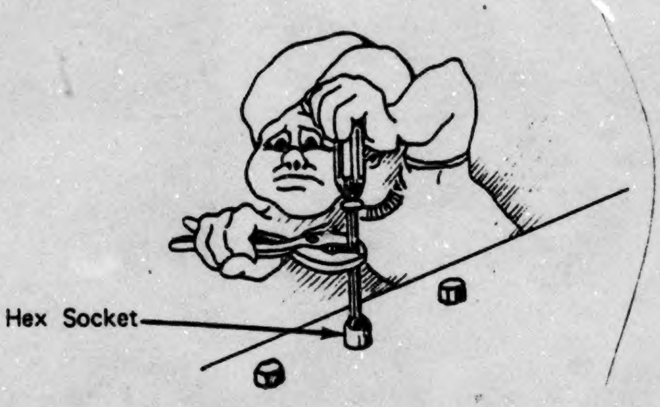
1. Drop light cords should not be run over with appliance dollys or other carts
2. Protect the blade on a hacksaw with a piece of cardboard to prevent dulling of the teeth



   (NOTE: The teeth of a hacksaw blade should always be pointing forward.)

3. Safety glasses should be kept in a case when not in use

4. Nut drivers should only be used on hand tight nuts, bolts, and screws; do not use pliers for increased leverage



5. Levels should never be dropped

6. Do not apply too much force to hex key wrenches

   (NOTE: Too much force will break or round out the socket of the set screw.)

J. Threading tools

1. Use plenty of cutting oil when threading

2. Do not keep taps and dies loose in a drawer

   (NOTE: This will dull the cutting teeth.)

V. Reading a rule (Transparencies 11, 12, and 13)

A. All rules read similarly

   (NOTE: Some rules are graduated with more divisions per inch than others.)

B. Procedure for reading

1. Count the divisions in one inch

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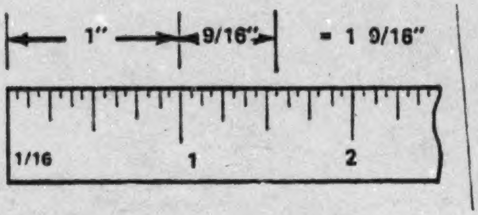
INFORMATION SHEET

2. Determine inches and divisions

    a. Count the graduations after the last full inch



    b. Add fractions to the last full inch

3. Reduce the fraction if possible

4. Determine the feet and add the inches and fraction of an inch to obtain a correct measurement

C. Guidelines for the use and care of rules and steel tapes

1. Use the proper length and graduation

2. Use finest graduation for accuracy

3. Use a good quality rule

4. Never bend or distort a steel rule

5. Use only for intended purpose

6. Rewind steel tapes slowly

VI. Cutting and threading iron pipe

A. Secure pipe in vise

B. Cut the pipe

(NOTE: Cut end must be square.)

C. Ream inside of pipe to remove burrs

D. Lightly file outside cut edge if necessary

E. Inspect and clean dies before threading

F. Check cutting edges for sharpness

INFORMATION SHEET

G. Be sure dies are in the die stock properly

H. Center die on pipe

I. Turn die slowly in a clockwise direction

J. Apply cutting oil while threading

(NOTE: A good grade of sulphur base cutting oil eases cutting and cools die threads.)

K. Determine length of the threaded portion

(NOTE: This can be determined by using Table 1.)

TABLE 1

SPECIFICATIONS FOR THREADING PIPE

Nominal Size of Pipe in Inches	Approx. Length of Threads in Inches	Approx. Number of Threads To Be Cut
1/2	3/4	10
3/4	3/4	10
1	7/8	10
1 1/4	1	11
1 1/2	1	11
2	1	11
2 1/2	1 1/2	12
3	1 1/2	12
4	1 3/4	13

L. Remove die by turning counterclockwise

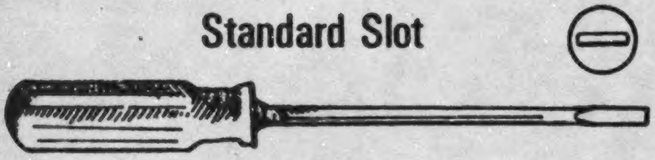
M. Clean chips from threads

N. Clean chips from dies

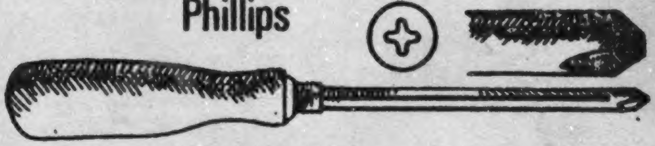
(CAUTION: Do not remove chips with compressed air.)

Screwdrivers

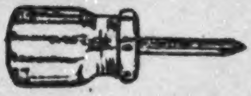
Standard Slot

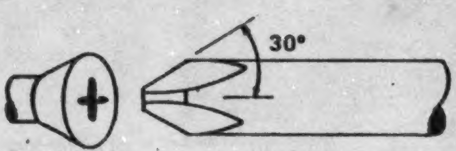


Phillips



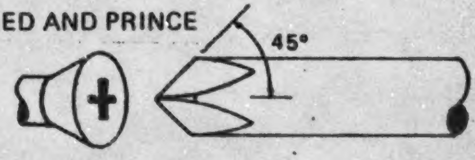
Stubby



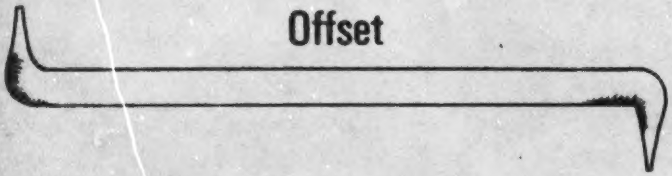


PHILLIPS

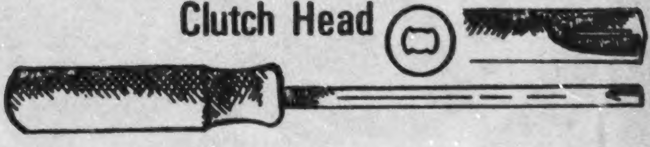
REED AND PRINCE



Offset

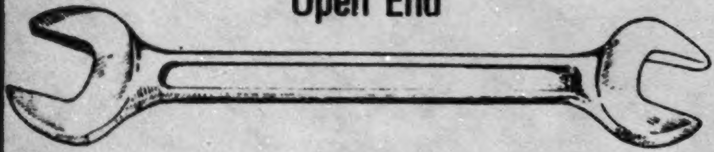


Clutch Head

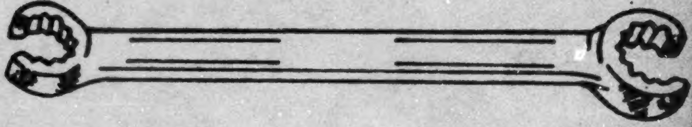


Wrenches

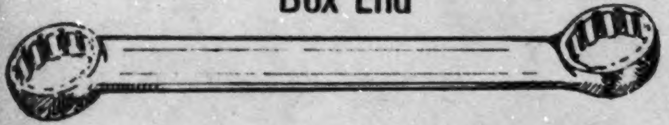
Open End



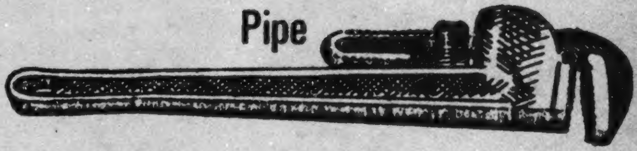
Flare Nut



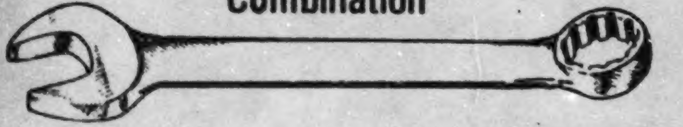
Box End



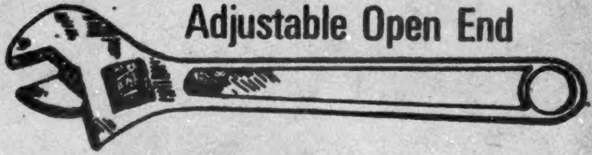
Pipe



Combination

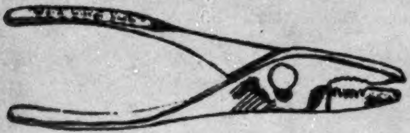


Adjustable Open End

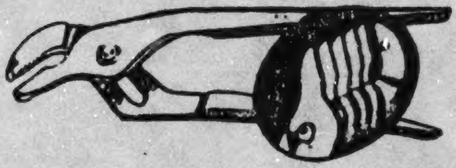


Pliers

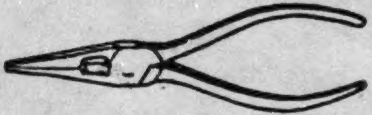
Slip Joint



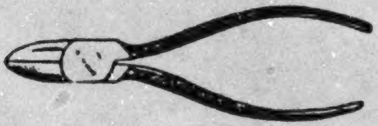
Slip Groove



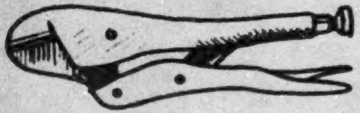
Long Nose



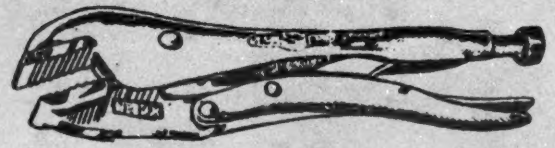
Diagonal Cutters



Pinch–Off

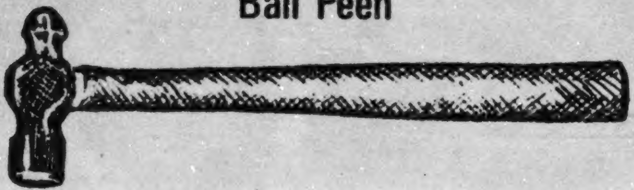


Plier Wrench

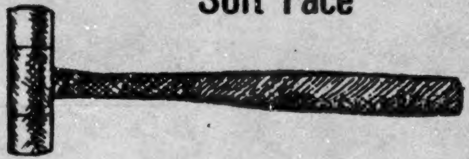


Hammers

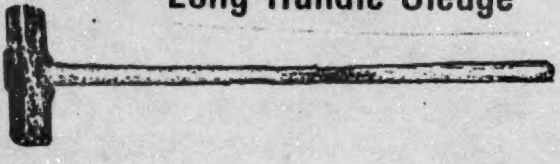
Ball Peen



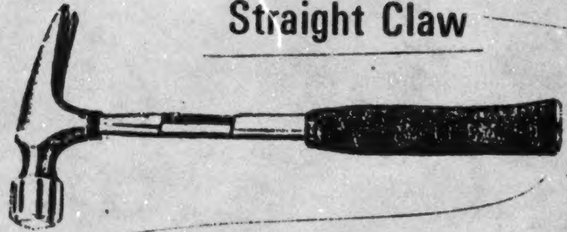
Soft Face



Long Handle Sledge

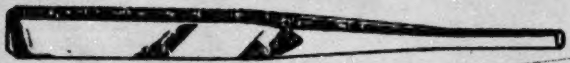


Straight Claw

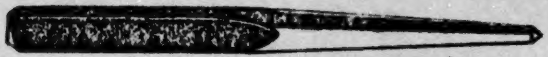


Punches, Chisels, and Bars

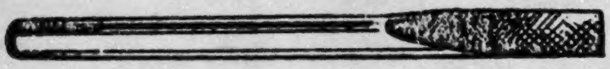
Pin Punch



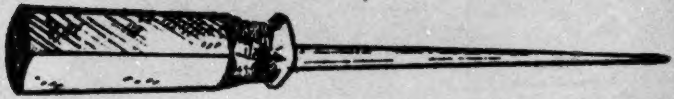
Center Punch



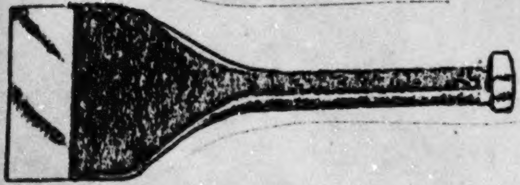
Flat Chisel



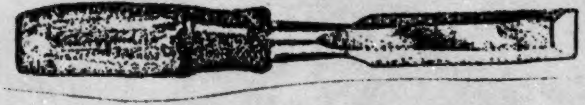
Scratch Awl



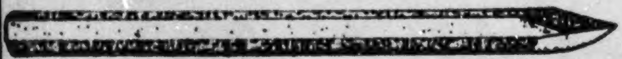
Flooring Chisel



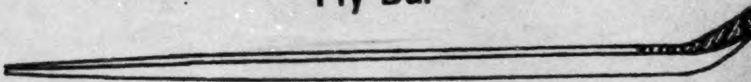
Wood Chisel



Bullnose Chisel

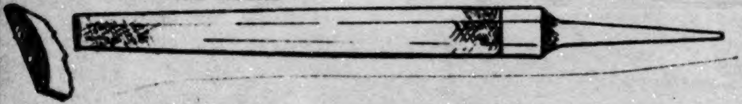


Pry Bar

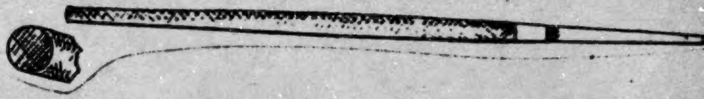


Files

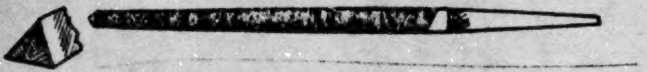
Half Round



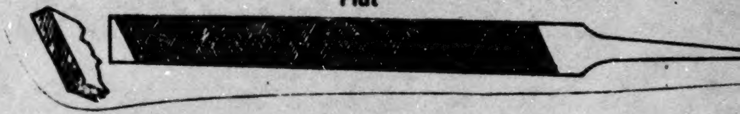
Round



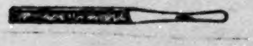
Triangular



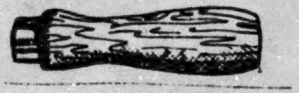
Flat



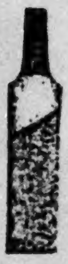
Point



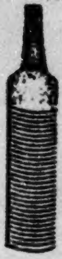
Handle



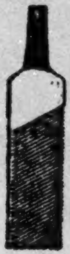
Types of File Teeth



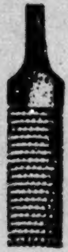
Single Cut



Curved Tooth



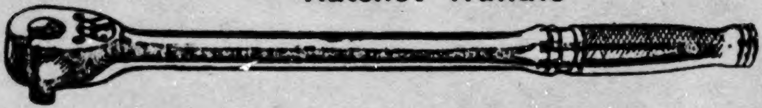
Double Cut



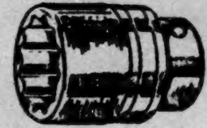
Rasp Cut

Socket Sets

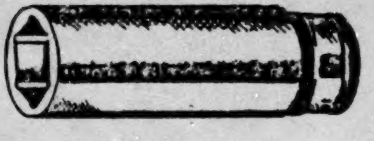
Ratchet Handle



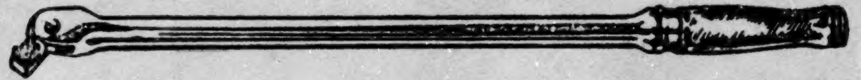
Socket



Deep Socket

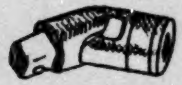


Hinge Handle (Break-Arm)

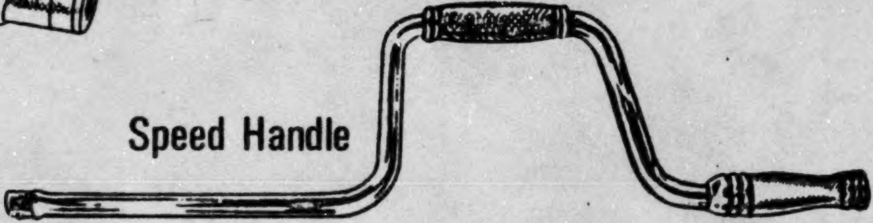


Extension

Universal Joint

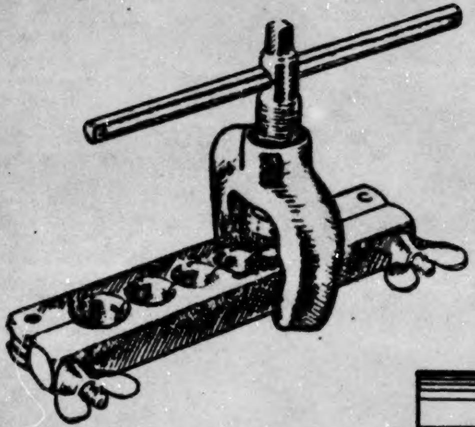


Speed Handle

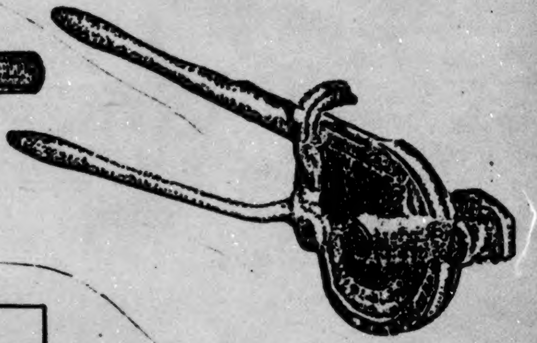


Tubing Tools

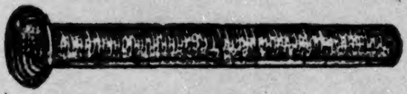
Flaring Tool and Block



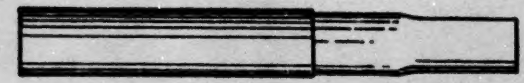
Geared Ratchet-Type Bender



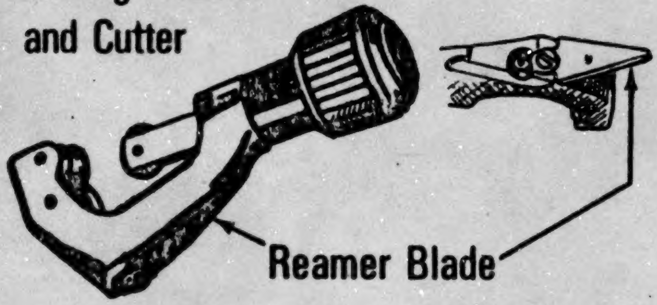
Bending Spring



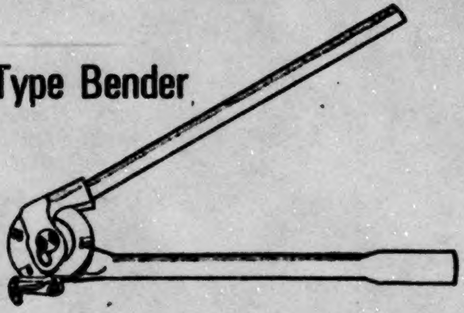
Swage Punch



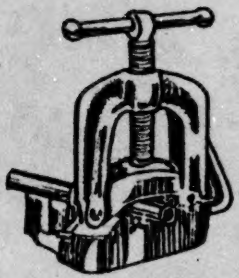
Tubing Reamer and Cutter



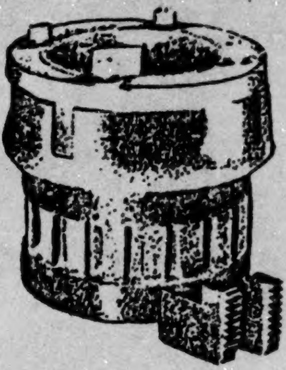
Lever Type Bender



Tools For Cutting and Threading Iron Pipe

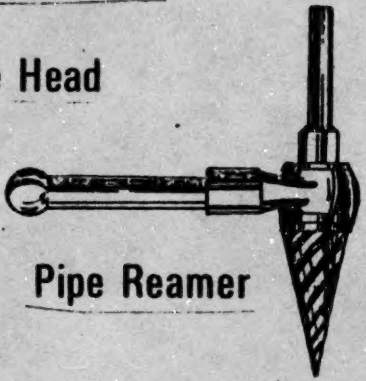


Pipe Vise

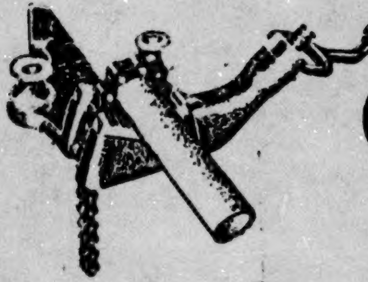


Die Head

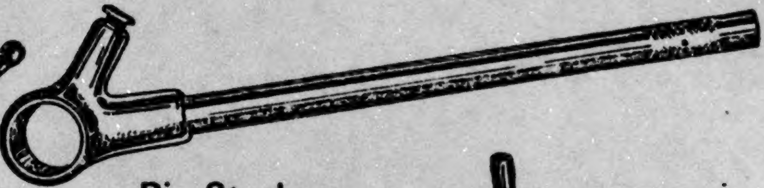
Dies



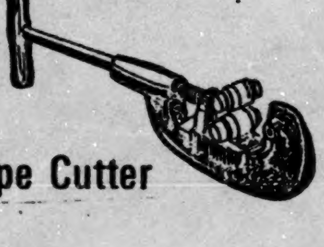
Pipe Reamer



Chain Vise

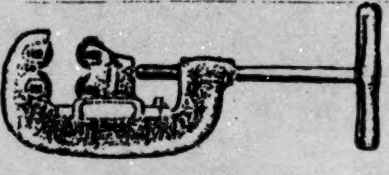


Die Stock

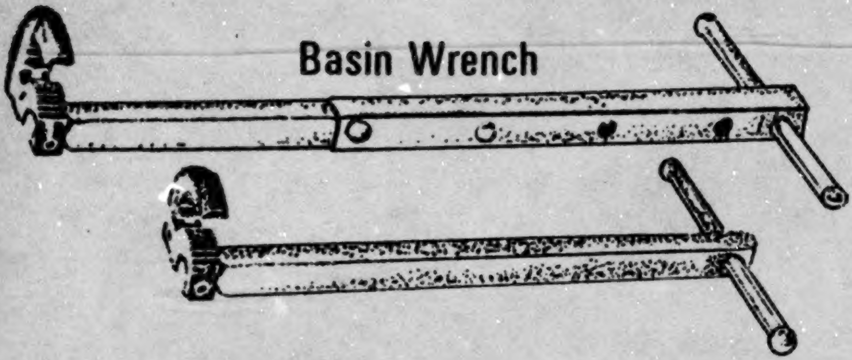


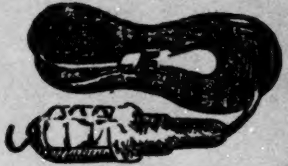
Pipe Cutter

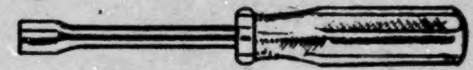
4–Wheel Pipe Cutter

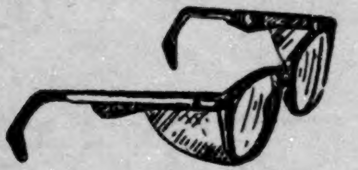


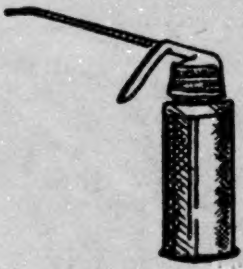
Accessory Hand Tools

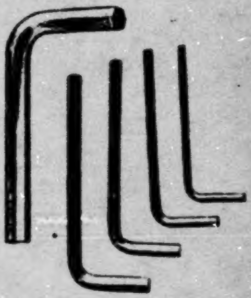

Basin Wrench


Drop Light

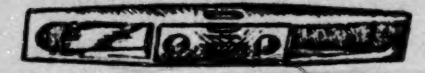

Nut Driver


Safety Glasses


Cutting Oil
or Lubricating

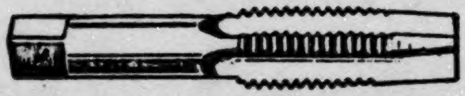

Hex Key Wrenches

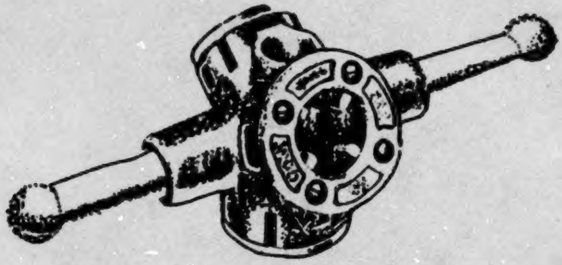
Hacksaw


Level

Threading Tools

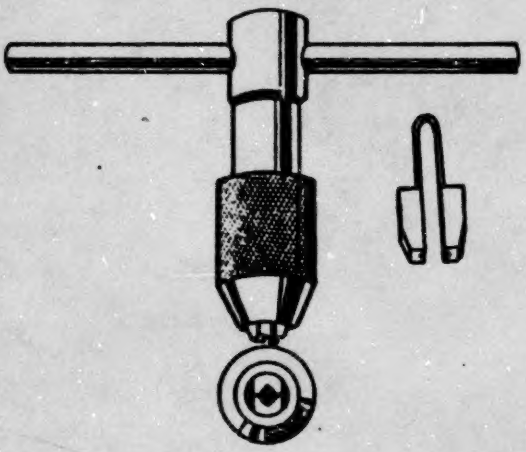
Tap

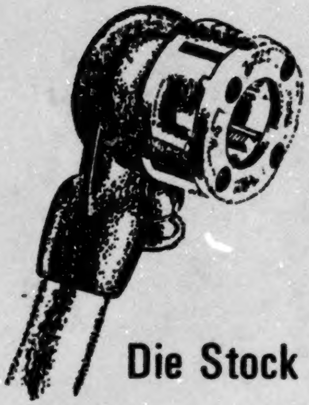




Three-way Pipe Die

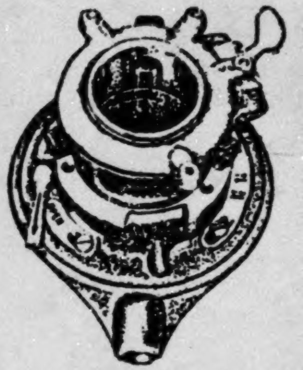
T-Handle Tap Wrench





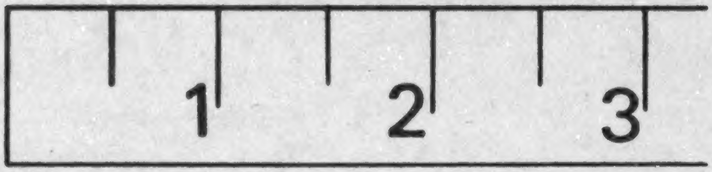
Die Stock

Stock and Die

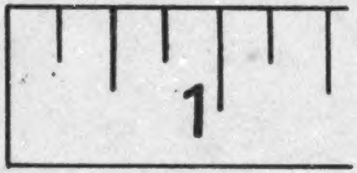


Graduations on a Rule

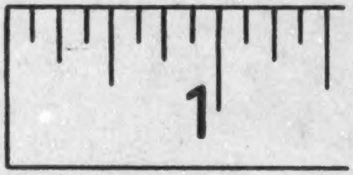
Halves



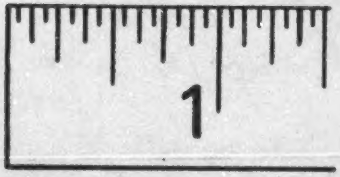
Quarters



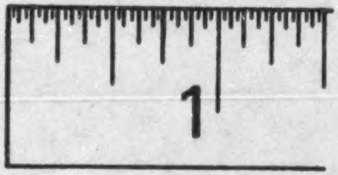
Eighths

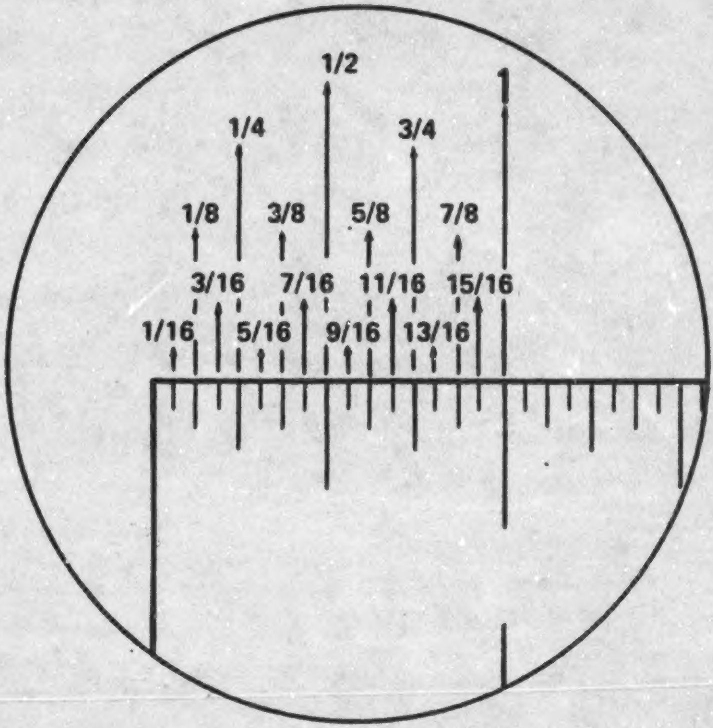


Sixteenths



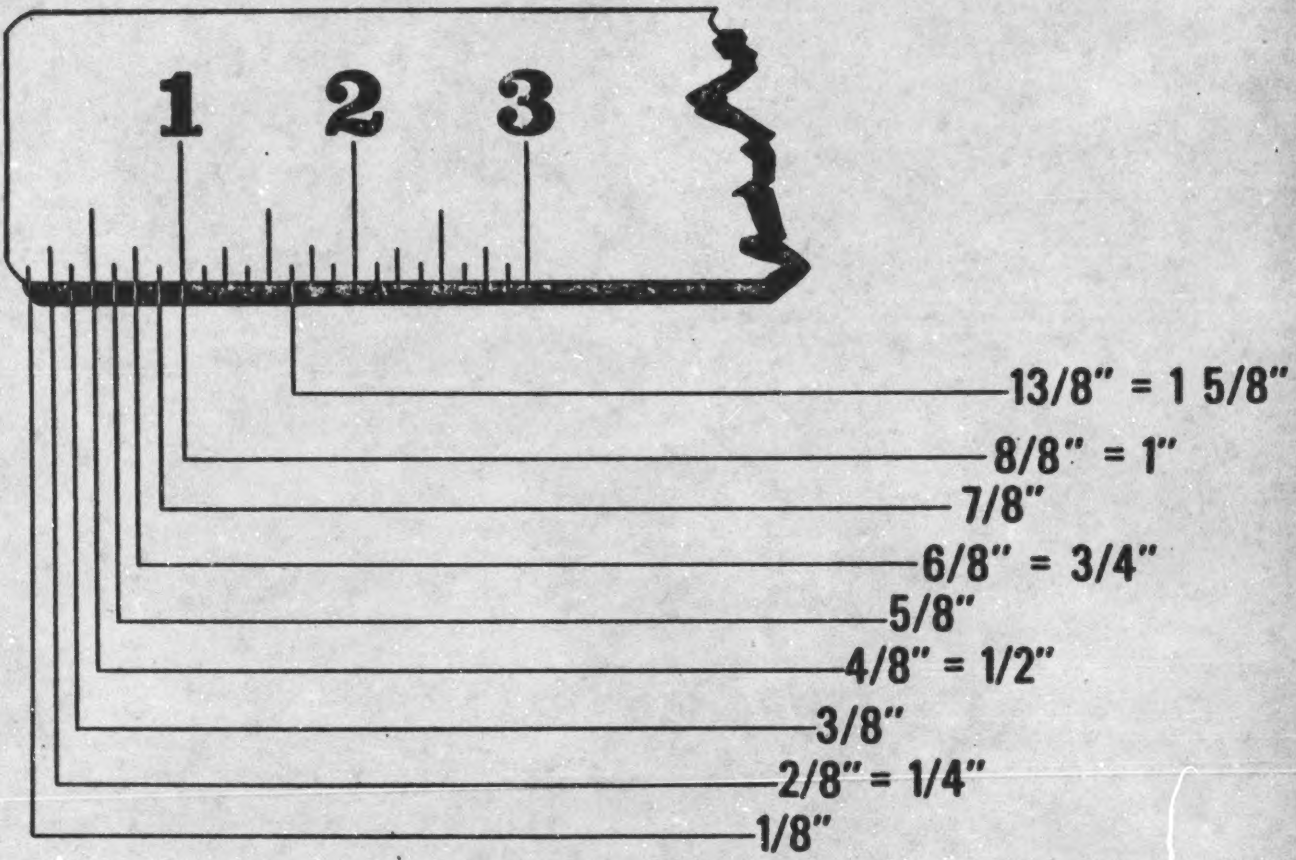
Thirty-Seconds



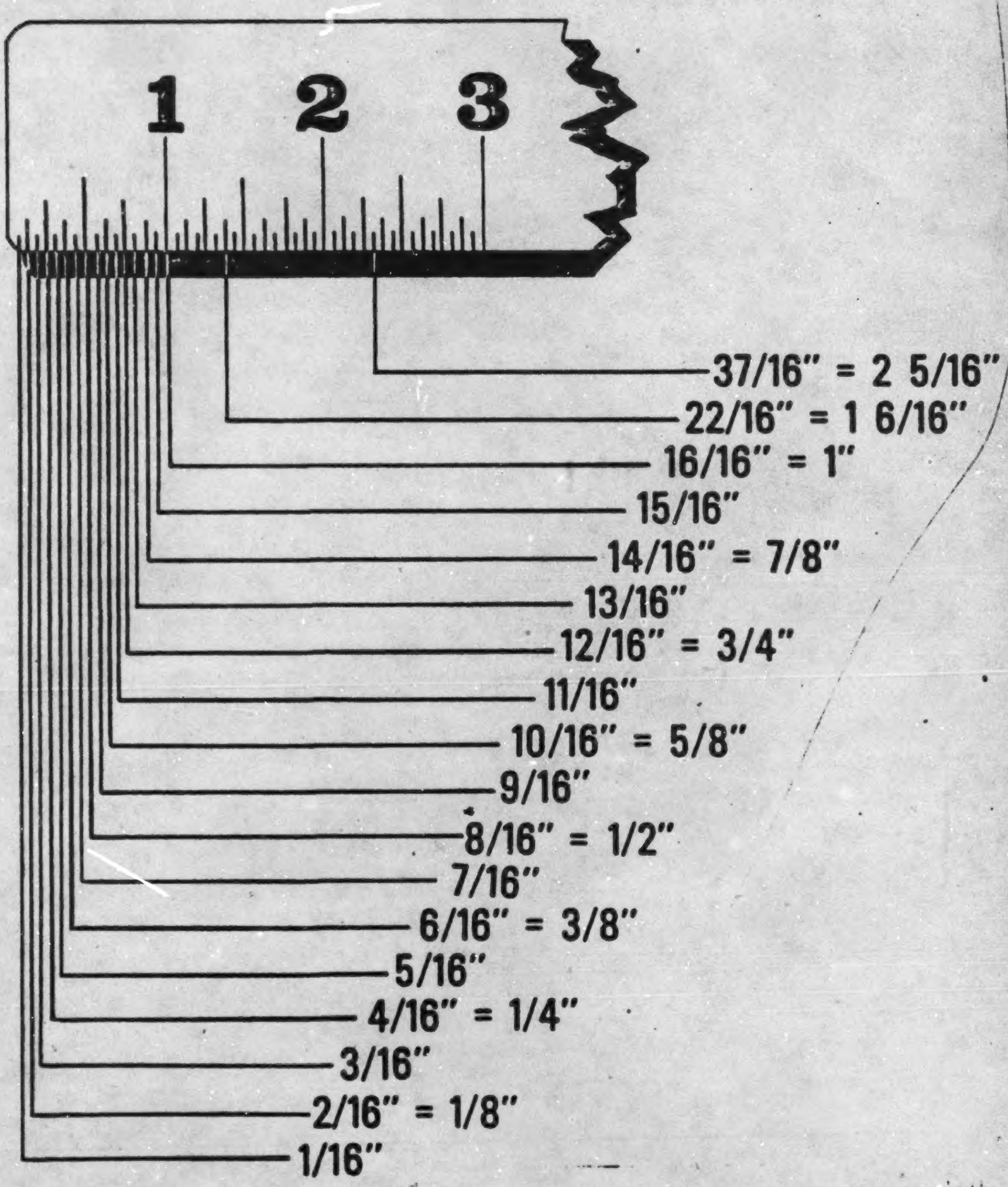

1/2
1
1/4
3/4
1/8
3/8
5/8
7/8
3/16
7/16
11/16
15/16
1/16
5/16
9/16
13/16

Graduations Applied to a Rule

Reading the Eighths Rule


1
2
3
13/8" = 1 5/8"
8/8" = 1"
7/8"
6/8" = 3/4"
5/8"
4/8" = 1/2"
3/8"
2/8" = 1/4"
1/8"

Reading the Sixteenths Rule


1
2
3
37/16" = 2 5/16"
22/16" = 1 6/16"
16/16" = 1"
15/16"
14/16" = 7/8"
13/16"
12/16" = 3/4"
11/16"
10/16" = 5/8"
9/16"
8/16" = 1/2"
7/16"
6/16" = 3/8"
5/16"
4/16" = 1/4"
3/16"
2/16" = 1/8"
1/16"

TM 1c.

P-47-B

BASIC HAND TOOLS
UNIT I

ASSIGNMENT SHEET #1–MEASURE LINES TO THE NEAREST QUARTER, EIGHTH AND SIXTEENTH OF AN INCH

1. Measure these lines to the nearest quarter of an inch.

   a. __________________________________

   b. ____

   c. __________

   d. _____________________

   Answers

   a. _________

   b. _________

   c. _________

   d. _________

2. Measure these lines to the nearest eighth of an inch.

   a. ____

   b. __________________________

   c. ______________________________________

   d. ____

   Answers

   a. _________

   b. _________

   c. _________

   d. _________

ASSIGNMENT SHEET #1

3. Measure these lines to the nearest sixteenth of an inch.

a. ____

b. ____________

c. ______________________________

d. ___________________________________

Answers

a. __________

b. __________

c. __________

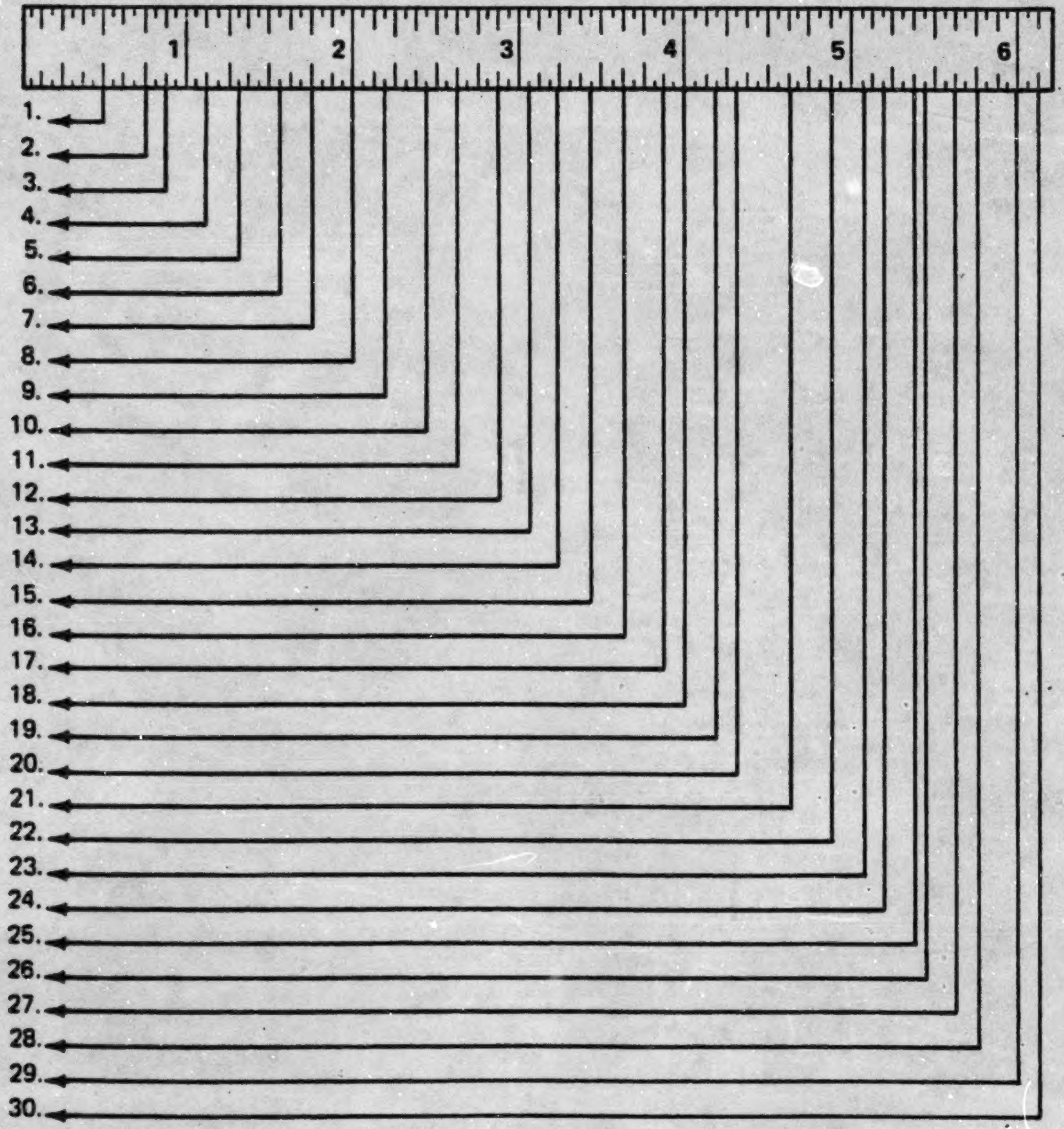
d. __________

50-B

ASSIGNMENT SHEET #2--READ A RULE/TAPE MEASURE

Determine the correct dimension for each arrow. Place answer on the arrow.

Example: Arrow 1 = 1/2"


1
2
3
4
5
6
1.
2.
3.
4.
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BASIC HAND TOOLS
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. a. 3 1/4"
   b. 4 1/2"
   c. 1"
   d. 2"
2. a. 4 3/4"
   b. 2 1/2"
   c. 3 5/8"
   d. 4 1/4"
3. a. 4 1/16"
   b. 1 1/16"
   c. 2 5/8"
   d. 3 5/16"

Assignment Sheet #2

2. 3/4"
3. 7/8"
4. 1 1/8"
5. 1 5/16"
6. 1 9/16"
7. 1 3/4"
8. 2"
9. 2 3/16"
10. 2 7/16"
11. 2 5/8"
12. 2 7/8"
13. 3 1/16"
14. 3 1/4"
15. 3 7/16"
16. 3 5/8"
17. 3 7/8"
18. 4"
19. 4 3/16"
20. 4 5/16"
21. 4 5/8"
22. 4 7/8"
23. 5 1/16"
24. 5 3/16"
25. 5 3/8"
26. 5 7/16"
27. 5 5/8"
28. 5 3/4"
29. 6"
30. 6 1/8"

BASIC HAND TOOLS
UNIT I

JOB SHEET #1--USE HAND TOOLS TO INSPECT/REPLACE WASHER IN A GLOBE VALVE

EVALUATION--Given access to tools, equipment and materials, inspect and/or replace a washer on a globe valve. Evaluation will include correct use of tools and equipment, correct evaluation of worm washer, and neatness of work habits.

I. Tools and materials

   A. Screwdriver

   B. Adjustable wrench

   C. Bench vise

   D. Globe valve

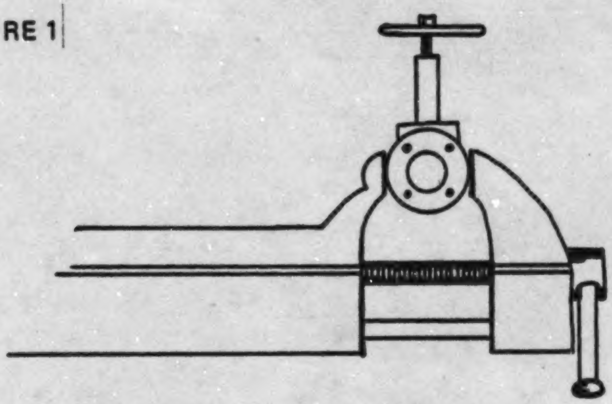
   E. New washer

II. Procedure

   A. Place valve in vise (Figure 1)

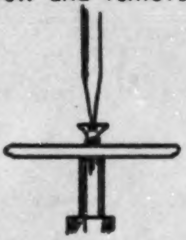
   (CAUTION: Do not damage valve by overtightening vise.)

FIGURE 1



   B. Unscrew the valve wheel screw and remove the valve wheel (Figure 2)

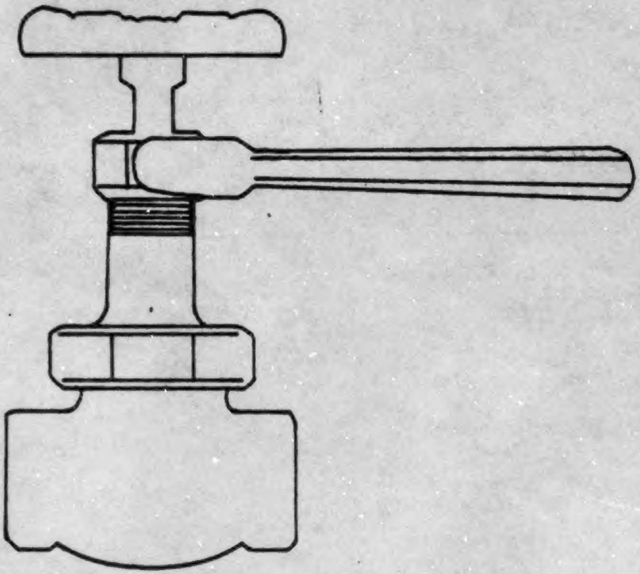
FIGURE 2



7-55-13

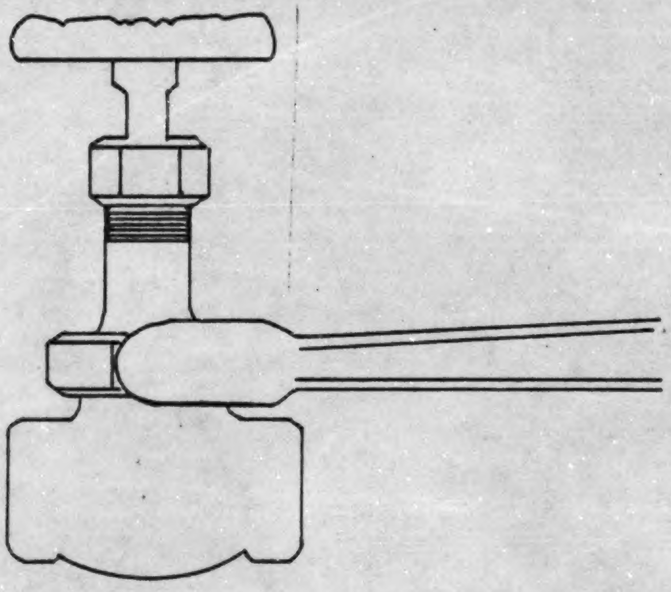
C. Loosen packing nut on valve stem (Figure 3)

FIGURE 3



D. Remove valve stem by loosening bonnet (Figure 4)

FIGURE 4



E. Instant washer for defects; replace if desired

F. Replace valve stem assembly (stem, bonnet, packing nut)

G. Replace valve wheel and wheel screw

56-3

BASIC HAND TOOLS
UNIT I

JOB SHEET #2--MEASURE AND MARK A PREDETERMINED LENGTH ON A PIPE

EVALUATION--Given access to tools, equipment and materials, measure and mark a predetermined length of pipe. Evaluation will include accuracy of measurement, care in handling measuring tools, and general neatness of the job.

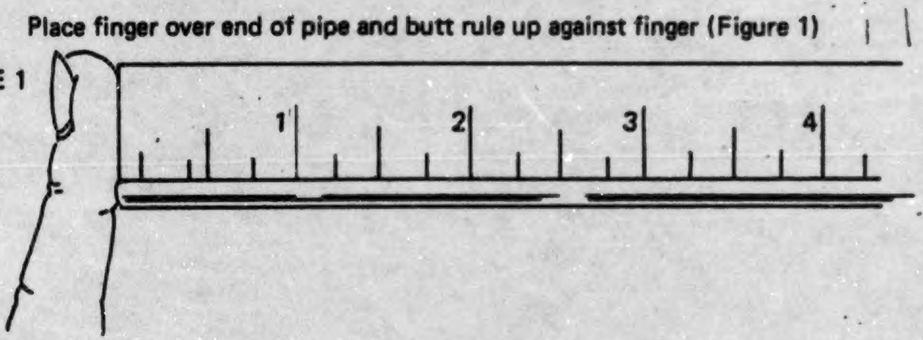
I. Tools and materials

- A. Six foot folding rule
- B. Pencil
- C. Length of pipe

II. Procedure

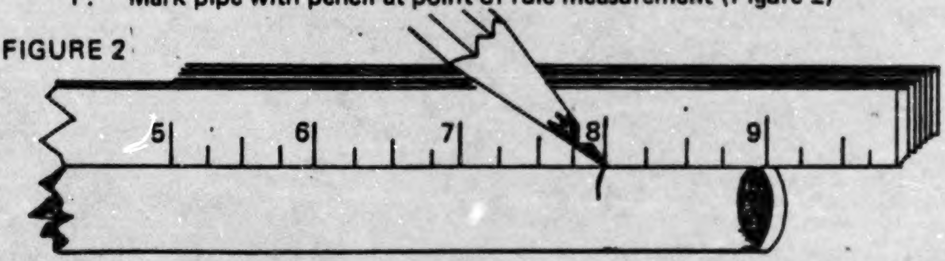
- A. Place pipe in suitable position for measuring
- B. Determine correct measurement to be made
- C. Open folding rule and lay on top of pipe
- D. Place finger over end of pipe and butt rule up against finger (Figure 1)

FIGURE 1



- E. Hold rule firmly on pipe and read predetermined measurement on rule
- F. Mark pipe with pencil at point of rule measurement (Figure 2)

FIGURE 2



JOB SHEET #3–USE HAND TOOLS TO CUT A LENGTH OF STEEL PIPE

EVALUATION–Given access to tools, equipment and materials, cut a length of steel pipe. Evaluation will include correct use of tools, accuracy of cut, and general neatness of work performed.

I. Tools and equipment

   A. Pipe vise

   B. Pipe cutter

   C. Steel pipe

   D. Cutting oil

   E. Safety glasses

   F. Shop towel

   G. Pencil

II. Procedure

   A. Put on safety glasses and gather tools and equipment

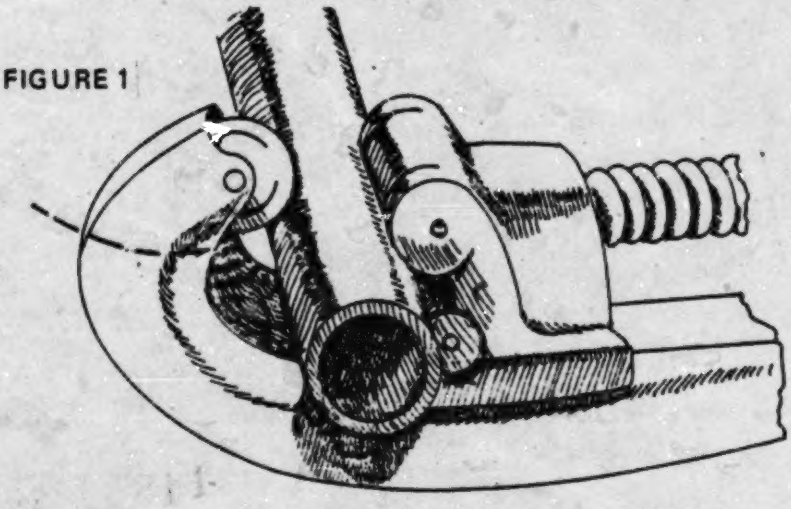
   B. Secure pipe in vise

   C. Mark place for cut with pencil

   D. Open pipe cutter until it will fit over pipe

   E. Locate cutter wheel on the pencil mark (Figure 1)

FIGURE 1



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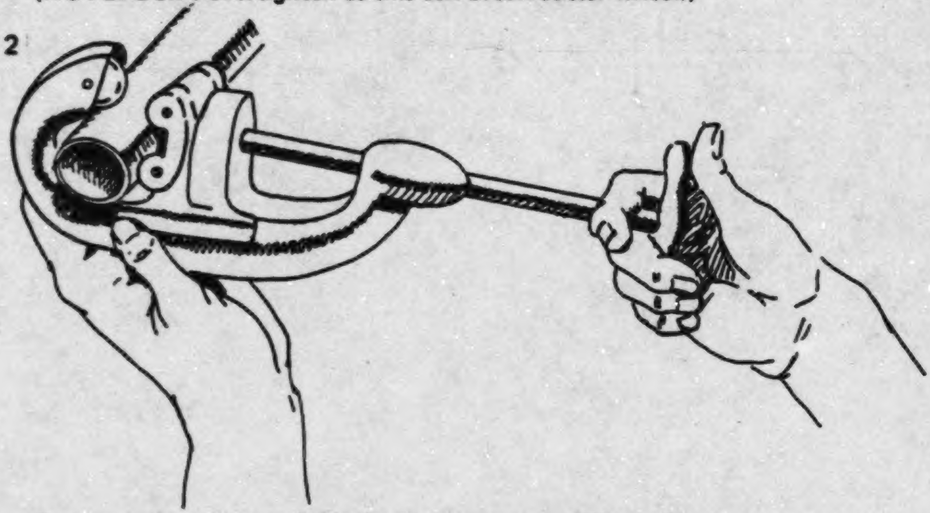
JOB SHEET #3

F. Snug cutter up to pipe by rotating screw handle (Figure 2)

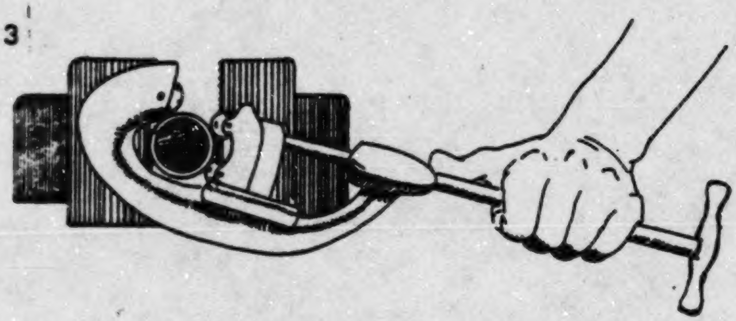
(NOTE: Don't overtighten as this can break cutter wheel.)

FIGURE 2



G. Rotate cutter counterclockwise to start groove (Figure 3)

FIGURE 3



H. Tighten cutter hand 1/4 of a turn for each full revolution around the pipe

(NOTE: Overtightening can cause cutters to break.)

I. Continue process until pipe is cut

(CAUTION: When cutting short pieces of pipe be careful not to cut your arm while rotating the cutter around the pipe.)

J. Clean pipe and cutter with shop towel

K. Have instructor inspect work

L. Put up tools and equipment

M. Clean up work area

BASIC HAND TOOLS
UNIT I

JOB SHEET #4–USE HAND TOOLS TO REAM STEEL PIPE

> EVALUATION–Given access to tools, equipment and materials, ream steel pipe. Evaluation will include correct use of tools, safety precautions used, accuracy of work performed, and general neatness of the job.

(NOTE: The purpose of reaming is to create a smooth surface to allow free flow of liquid.)

I. Tools and equipment

   A. Pipe vise

   B. Reamer

      (NOTE: You will need a ratchet hand or brace, depending on which type reamer used.)

   C. Piece of steel pipe

   D. Safety glasses

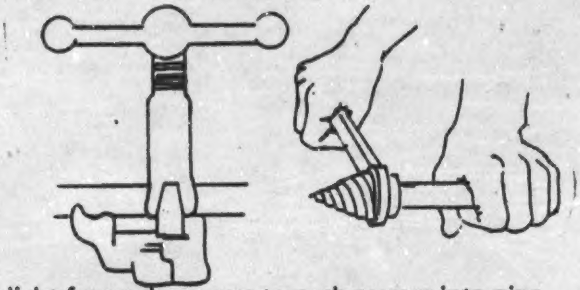
II. Procedure

   (NOTE: Be safety conscious around cut pieces of steel pipe. Sharp ridges or spurs can cause deep cuts.)

   A. Place pipe in vise

   B. Insert reamer tip in pipe (Figure 1)

FIGURE 1

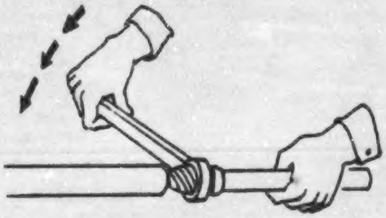


   C. Apply light forward pressure to push reamer into pipe

   D. Start rotating reamer (Figure 2)

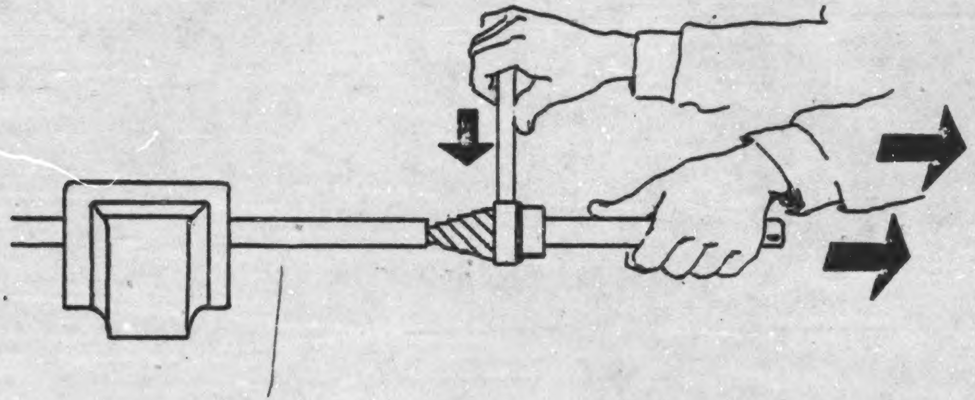
      (NOTE: Reamer should bite instantly if proper pressure is applied. Reamer can be damaged if rotated in the wrong direction.)

FIGURE 2



E. Rotate reamer until burrs are removed (Figure 3)

FIGURE 3



(NOTE: This is a developed skill; the reamer can be pulled out and your progress inspected.)

F. Pull reamer back while continuing to rotate (Figure 4)

(NOTE: This prevents the reamer from leaving a burr.)

G. Have your instructor evaluate your work

H. Put up all tools and equipment

JOB SHEET #5–USE HAND TOOLS TO CUT PIPE THREADS

EVALUATION–Given access to tools, equipment and materials, cut pipe threads. Evaluation will include correct use of tools, safety precautions used, accuracy of work performed and general neatness of the job.

I. Tools and materials

A. Die

B. Die stock

C. Vise

D. Flat file

E. Oil can (cutting oil)

F. Steel pipe

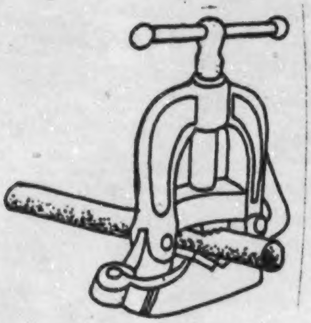
(NOTE: Ask the instructor what type and size of steel pipe to use for this job.)

G. Safety glasses

II. Procedure

A. Place pipe in vise (Figure 1)

FIGURE 1



B. Lubricate end of pipe with cutting oil

C. Place die in die stock and secure

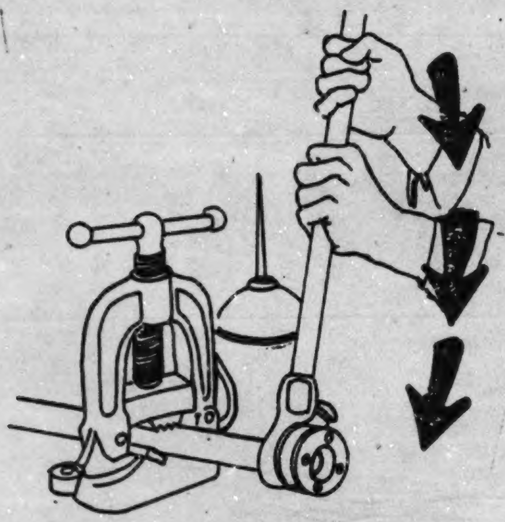
D. Place die on pipe

E. Start die straight on the pipe

JOB SHEET #5

G. Press evenly and turn the die (Figure 2)

FIGURE 2



H. Apply plenty of cutting oil while turning the die

(NOTE: Place a container under pipe vise to catch dripping oil.)

I. Continue this procedure until the desired amount of threads have been cut

J. Remove die by turning counterclockwise

(NOTE: Hold onto the die stock firmly while removing it so it won't be dropped when it comes to the end of the threads.)

K. Clean threads with a brush

(CAUTION: Do not use compressed air for cleaning.)

L. Have instructor inspect work

M. Clean up tools, put them away, and clean the area

BASIC HAND TOOLS
UNIT I

JOB SHEET #6--SET UP AND USE A HACKSAW

EVALUATION--Given access to tools, equipment and materials, set up and use a hacksaw. Evaluation will include safety precautions used, correct use of tools and equipment, accuracy of cut, and general neatness of the work performed.

I. Tools and equipment

   A. Hacksaw frame

   B. Hacksaw blade

      (NOTE: For cutting pipe a 24 or 32 teeth/inch blade is recommended.)

   C. Pipe

   D. Pipe vise

   E. Safety glasses

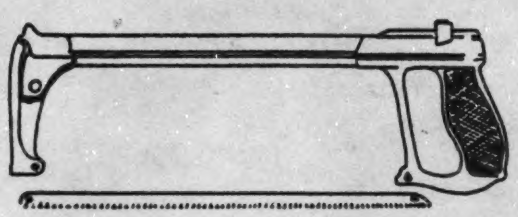
II. Procedure

   A. Put on safety glasses and gather tools and equipment

   B. Insert blade in frame and tighten (Figure 1)

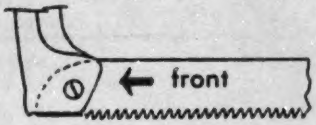
      (NOTE: Hand tighten only; being too tight can cause the blade to shatter.)

FIGURE 1



(NOTE: Be sure teeth angles are pointed toward the front of the saw. See Figure 2.)

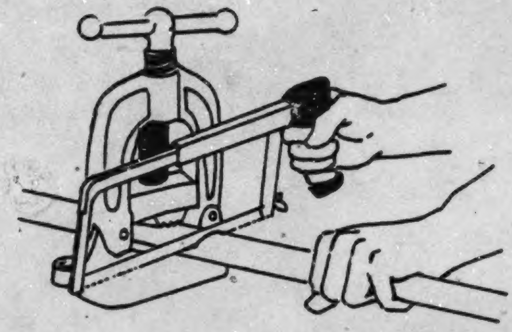
FIGURE 2



C. Secure pipe for cutting (Figure 3)

(NOTE: Short pieces of pipe are easier to cut if secured in a vise.)

FIGURE 3



D. Rest the blade on the pipe at the point to be cut

E. Push forward gently until cut is started

(NOTE: Exert downward pressure only on the forward stroke.)

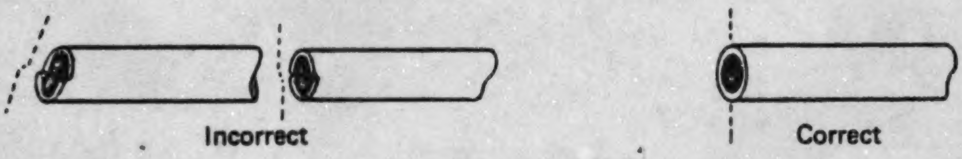
F. Make reciprocal strokes until cut is finished

(NOTE: Excessive speed while cutting can ruin blades. You should not use over thirty full strokes per minute.)

G. Have the instructor check your cut (Figure 4)

(NOTE: Your cut should be straight and relatively smooth.)

FIGURE 4



Incorrect

Correct

BASIC HAND TOOLS
UNIT I

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Tool which is hand held and is not electrical or specialized

_____b. Tool designed for a particular use

_____c. Personalized tool kit containing the basic hand tools

_____d. Plumber's tools used for cutting pipe

_____e. Tools used to turn threaded pipe and fittings, made in a variety of sizes and shapes

_____f. Method of developing spiral cuts on pipe in order to facilitate joining

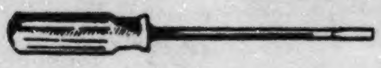
_____g. Designates joints of pipe in reference to the fitting; female receives the male pipe

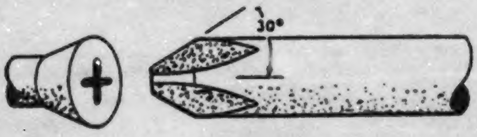
_____h. A special thread designed for piping systems; does not fit objects with machine threads

_____i. The condition of being safe from undergoing or causing hurt, injury, or loss

1. Threading
2. Male/female
3. Pipe wrenches
4. Plumber's tool box
5. Pipe cutters
6. Specialized tool
7. Hand tool
8. Pipe thread
9. Safety

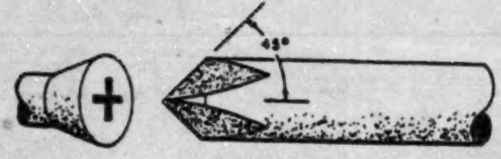
2. Identify the basic hand tools.



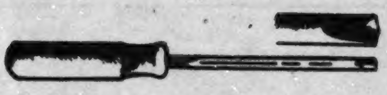


a. ______________________ b. ______________________

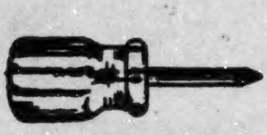
p-L-1-3



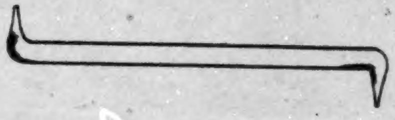
c. ______________________



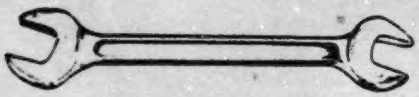
d. ______________________



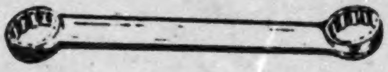
e. ______________________



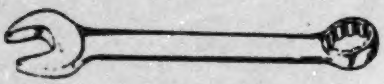
f. ______________________



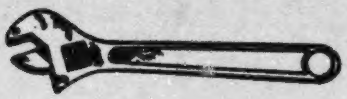
g. ______________________



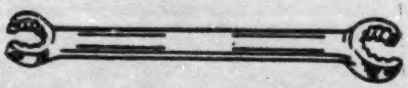
h. ______________________



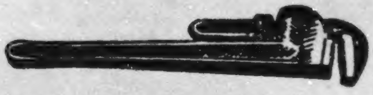
i. ______________________



j. ______________________

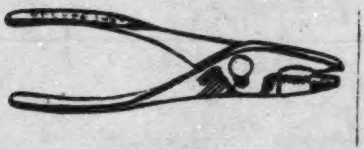


k. ______________________

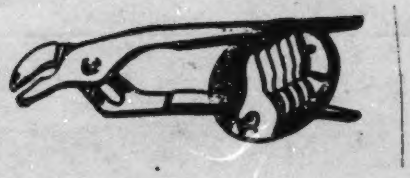


l. ______________________

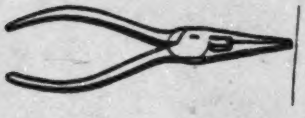
16-B



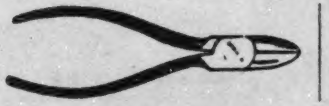
m. ____________________



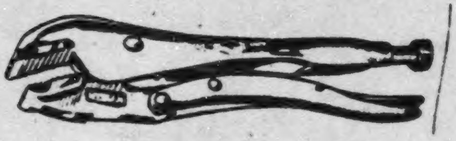
n. ____________________



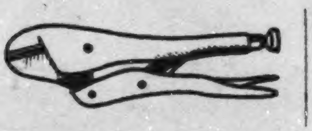
o. ____________________



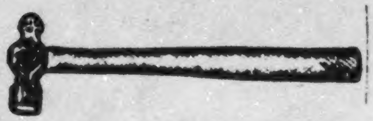
p. ____________________



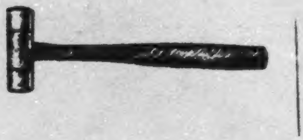
q. ____________________



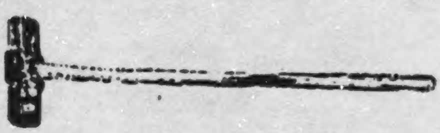
r. ____________________



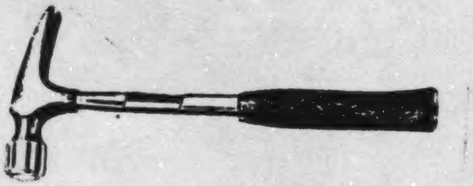
s. ____________________



t. ____________________



u. ____________________



v. ____________________

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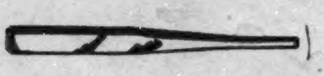
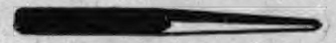
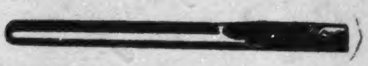


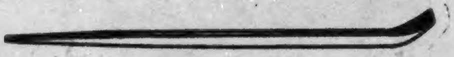
w.



x.



y.



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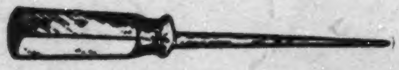

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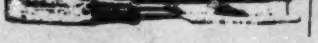

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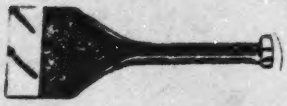
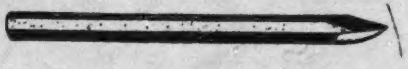


cc.



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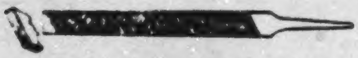

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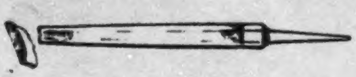

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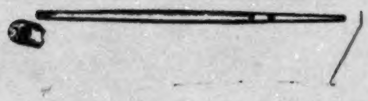

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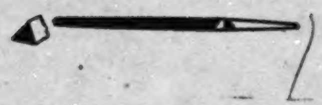

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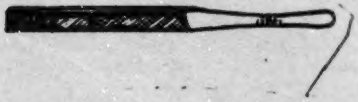

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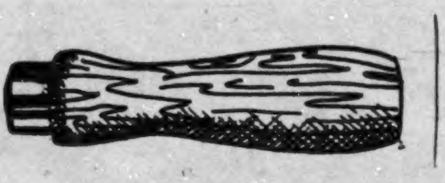

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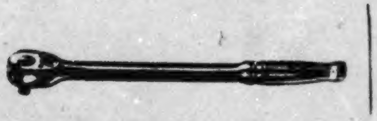

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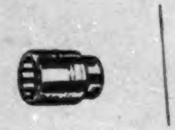

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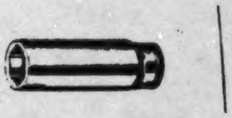

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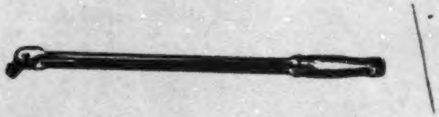

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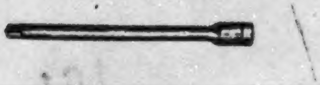

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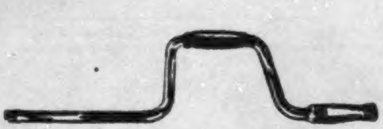

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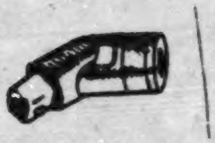

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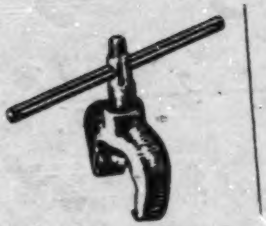

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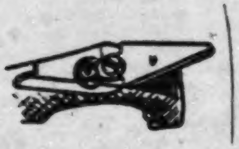

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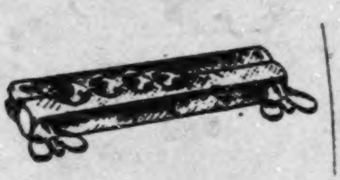

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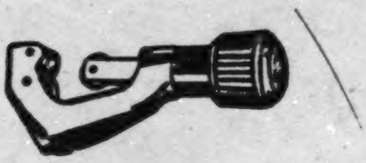

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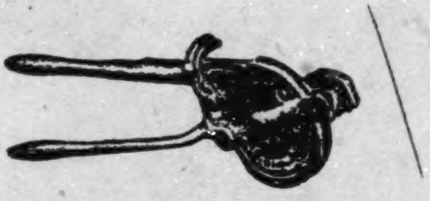

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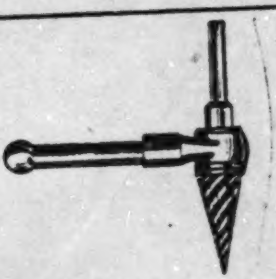

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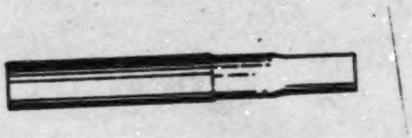

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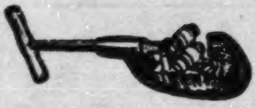

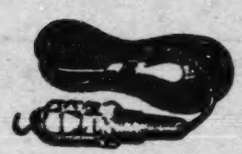

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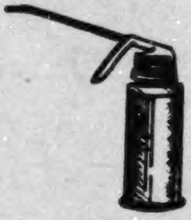

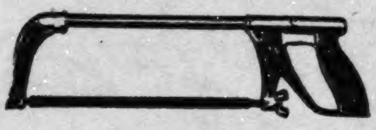

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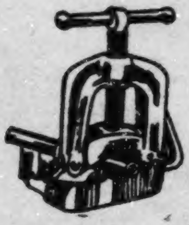

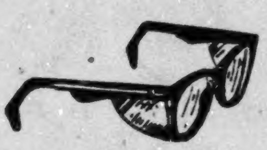

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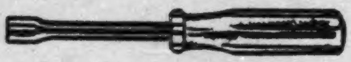

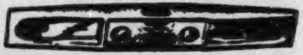

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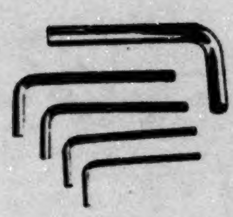

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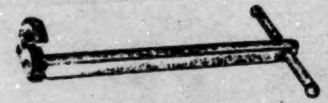

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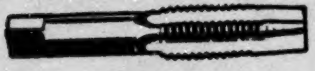

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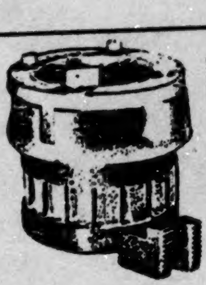

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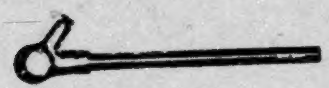

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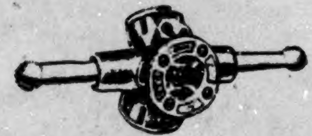

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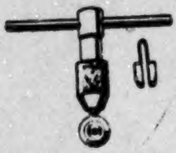

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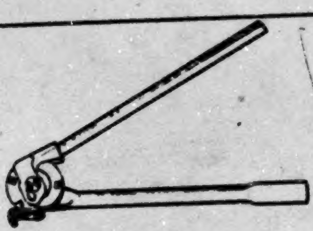

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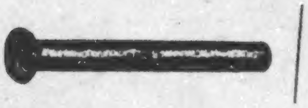

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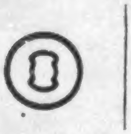
3. Select specific tools from similar groups.

   a. Place an "X" by the screwdriver that would fit the screw slot shown.



_____1) Standard slot

_____2) Phillips

_____3) Clutch head

_____4) Stubby

_____5) Offset

   b. Place an "X" by the wrench that is primarily used on rounded surfaces.

_____1) Open end

_____2) Box end

_____3) Combination box and open end

_____4) Adjustable open end

_____5) Pipe

_____6) Flare nut

c. Place an "X" by the pliers that are used for holding or reaching small items.

______1) Slip joint

______2) Slip groove

______3) Long nose

______4) Diagonal cutters

______5) Plier wrench

d. Place an "X" by the hammer that would be used on a brass surface and not mar it.

______1) Ball peen

______2) Soft face

______3) Sledge

______4) Claw

e. Place an "X" by the item that would be used when making indentations in metal for starting a drill.

______1) Pin punch

______2) Center punch

______3) Flat chisel

______4) Pry bar

______5) Scratch awl

f. Place an "X" by the file used generally for cleaning up damaged threads.

______1) Flat

______2) Half round

______3) Round

______4) Point

______5) Triangular

______6) File handle

g. Place an "X" by the items that are not drive handles.

_____1) Ratchet

_____2) Socket

_____3) Deep socket

_____4) Hinge handle

_____5) Extension

_____6) Speed handle

_____7) Universal joint

h. Place an "X" by the items needed to cut a piece of tubing from a roll and flare one end and swage the other end.

_____1) Flaring tool

_____2) Tubing reamer

_____3) Flare block

_____4) Cutter

_____5) Swage punch

_____6) Lever type bender

_____7) Bending spring

i. Place an "X" by the item that should be used on all jobs.

_____1) Drop light

_____2) Oil can

_____3) Hacksaw

_____4) Safety glasses

_____5) Nut drivers

_____6) Level

_____7) Hex key wrenches

j. Place an "X" by the tool that is used for cutting external threads.

_____1) Taps

_____2) Dies

_____3) Handles

P-14-B

4. Discuss the proper care of hand tools.

   a. Screwdrivers

   b. Wrenches

   c. Pliers

   d. Hammers

   e. Punches, chisels, and bars

50-D

f. Files

g. Socket sets

h. Tubing tools

i. Accessory hand tools

j. Threading tools

5. Demonstrate the ability to:

   a. Measure lines to the nearest quarter, eighth, and sixteenth of an inch.

   b. Read a rule/tape measure.

   c. Use hand tools to inspect/replace a washer on a globe valve.

   d. Measure and mark a predetermined length on a pipe.

   e. Use hand tools to cut a length of steel pipe.

   f. Use hand tools to ream steel pipe.

   g. Use hand tools to cut pipe threads.

   h. Set up and use a hacksaw.

   (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

BASIC HAND TOOLS
UNIT I

ANSWERS TO TEST

1. a. 7
   b. 6
   c. 4
   d. 5
   e. 3
   f. 1
   g. 2
   h. 8
   i. 9

2. a. Standard slot screwdriver
   b. Phillips screwdriver
   c. Reed and Prince screwdriver
   d. Clutch head screwdriver
   e. Stubby screwdriver
   f. Offset screwdriver
   g. Open end wrench
   h. Box end wrench
   i. Combination wrench
   j. Adjustable open end wrench
   k. Flare nut wrench
   l. Pipe wrench
   m. Slip joint pliers
   n. Slip groove pliers
   o. Long nose pliers
   p. Diagonal cutters
   q. Plier wrench
   r. Pinch-off pliers
   s. Ball peen hammer

P-03-B

t. Soft face hammer
u. Long handle sledge hammer
v. Straight claw hammer
w. Pin punch
x. Center punch
y. Flat chisel (cold chisel)
z. Pry bar
aa. Scatch awl
bb. Wood chisel
cc. Flooring chisel
dd. Bullnose chisel
ee. Flat file
ff. Half round file
gg. Round file
hh. Triangular file
ii. Point file
jj. File handle
kk. Ratchet handle
ll. Socket
mm. Deep socket
nn. Hinge handle (break-arm)
oo. Extension
pp. Speed handle
qq. Universal joint
rr. Flaring tool
ss. Tubing reamer
tt. Flaring block
uu. Cutter
vv. Geared ratchet-type bender

ww. Pipe reamer
xx. Swage punch
yy. Pipe cutter
zz. Drop light
aaa. Cutting oil or lubricating oil
bbb. Hacksaw
ccc. Pipe vise
ddd. Safety glasses
eee. Nut drivers
fff. Level
ggg. Hex key wrenches
hhh. Basin wrench
iii. Tap
jjj. Dies and die head
kkk. Die stock
lll. Three-way pipe die
mmm. T-Handle tap wrench
nnn. Lever type bender
ooo. Bending spring

3. a. 3
b. 5
c. 3
d. 2
e. 2
f. 5
g. 2, 3, 5, 7
h. 1, 2, 3, 4, 5
i. 4
j. 2

4. Discussion should include:
a. Screwdrivers
1) Grind flat tip square
2) Discard worn phillips tips
3) Do not hammer on screwdrivers

b. Wrenches

    1) Turn adjustables in proper direction

    2) Do not hammer on wrenches

    3) Do not hammer with wrenches

c. Pliers

    1) Do not use in place of wrench

    2) Have handles insulated when working on electrical circuits

d. Hammers

    1) Keep handles tight

    2) Use the proper type hammer for the job

e. Punches, chisels, and bars

    1) Keep cutting edges and points sharp

    2) Keep head ground to prevent mushrooming

f. Files

    1) Keep files on a wall rack

    2) Do not hammer or pry with a file

g. Socket sets

    1) Do not use an extension pipe or cheater bar on the handle of a ratchet

    2) Do not use a handle and extension pipe with thin wall sockets

h. Tubing tools

    1) Oil threads on flaring tool

    2) Replace cutting wheel on cutter when dull

i. Accessory hand tools

    1) Drop light cords should not be run over with appliance dollys or other carts

    2) Protect the blade on a hacksaw with a piece of cardboard to prevent dulling of the teeth

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        3) Safety glasses should be kept in a case when not in use

        4) Nut drivers should only be used on hand tight nuts, bolts, and screws; do not use pliers for increased leverage

        5) Levels should never be dropped

        6) Do not apply too much force to hex key wrenches

    j. Threading tools

        1) Use plenty of cutting oil when threading

        2) Do not keep taps and dies loose in a drawer

5. Performance skills evaluated to the satisfaction of the instructor

POWER TOOLS
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify power tools used by the plumber. The student should also be able to discuss the use of power tools and list safety precautions to be taken when using them. This knowledge will be evidenced by correctly performing the procedures outlined on the job sheets and by scoring 85 percent on the unit test.

(NOTE: The student must score one hundred percent on the safety section of the test.)

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Define terms associated with power tools and the use of power tools
2. Identify power tools generally used in residential plumbing.
3. Discuss the use and care of power tools used in residential plumbing.
4. List safety precautions to be applied in the use of power tools used in residential plumbing.
5. Demonstrate the ability to:
    a. Install a lavatory hanger on a concrete wall.
    b. Cut out a bathtub drain opening in a plywood floor.
    c. Thread steel pipe with a power-driven vise stand.

7-29-8

POWER TOOLS
UNIT II

SUGGESTED ACTIVITIES

I. Instructor

   A. Provide student with objective sheet.

   B. Provide student with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Conduct a tour of the shop and identify equipment.

   F. Invite a manufacturer's representative to address the class.

   G. Conduct a demonstration of drilling holes through a rim joint.

   H. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete job sheets.

   D. Take test

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Drilling Machines

      2. TM 2--Saws

      3. TM 3--Concrete Tools

      4. TM 4--Threading Machines

      5. TM 5--Sewer and Drain Cleaning Equipment

D. Job Sheets

1. Job Sheet #1–Install a Lavatory Hanger on a Concrete Wall
2. Job Sheet #2–Cut Out a Bathtub Drain Opening in a Plywood Floor
3. Job Sheet #3–Thread Steel Pipe With a Power Driven Vise Stand

E. Test

F. Answers to test

II. References:

A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, Ill: Goodheart-Willcox Co., Inc., 1978.

B. Bureau of Naval Personnel. *Tools and Their Uses.* Washington, D.C.: U.S. Government Printing Office, 1971.

C. Jacobs, Clinton O., and J. Howard Turner. *Developing Shop Safety Skills.* Athens, Ga.: American Assn. for Vocational Instructional Materials, 1979.

POWER TOOLS
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Power tools--Tools operated with electricity, air, or gasoline

B. Hand tools--Tools which are hand held and are not operated by electricity, air, or gasoline

C. Roughing-in tools--Tools, both hand and power, used to install the initial stage of the building's plumbing, including cutting and drilling access holes, and connecting piping

D. Reciprocating--Moving in a back and forth motion, as opposed to a circular motion

E. Abrasive--Cutting and grinding of material by a thin wheel made of a hard stone-like substance

II. Power tools generally used by the residential plumber

A. Drilling machines (Transparency 1)

(NOTE: These are often referred to as drills. The sizes of drilling machines are classified by the maximum size straight shank drill they will hold.)

1. Electric drill - 1/4"
2. Electric drill - 1/2"
    a. Straight
    b. Angle
3. Assortment of wood bits
4. Extension

B. Saws (Transparency 2)

1. Portable electric saw
2. Hole saw
3. Bench band saw
4. Circular saw

P-93-B

5. Band saw (portable)
6. Sabre saw

C. Concrete tools (Transparency 3)
   1. Electric rotary hammer
   2. Air hammer
   3. 3/8" hammer drill
   4. Electric chipping hammer

D. Threading machines (Transparency 4)
   1. Portable electric pipe threader
   2. Portable power drive
   3. Portable power driven vise stand
   4. Pipe support

E. Sewer and drain cleaning equipment (Transparency 5)
   1. Electric snake
   2. Power drain cleaner
      a. Electric
      b. Compressed air or gasoline
   3. Glove

III. Use and care of power tools

A. Drilling machines
   1. Small drills (1/4") develop more R.P.M.'s than large drills because the larger units are designed to turn larger cutting tools or to drill in heavy materials, and both of these factors require a slower speed
   2. The chuck key should be strapped to the power cord

      (NOTE: Loss of the chuck key promotes short tempers, poorly improvised substitutes for the key, and poor drilling jobs.)
   3. The cutting tool must be kept sharp in order to avoid forcing the machine and causing unnecessary wear and short life

INFORMATION SHEET

(NOTE: Before cutting out for pipe, make sure all nails have been pulled from the area.)

4. Drilling machines should be kept in the storage box when not in use in order to avoid damage

B. Saws

1. Saw blades should be kept sharp in order to avoid excessive forcing of the machine
2. Portable electric circular saws are used for cutting lumber, but can be fitted with abrasive wheels to cut metal and concrete
3. Power saws should be operated at a limited speed of cut in order to avoid blade breakage
4. Reciprocating power saws are often used for cutting irregular shaped pipe holes and openings especially in difficult to-get-at places
5. Small reciprocating power saws (saber saws) are helpful in cutting out countertops for kitchen sinks
6. Hole saws cut holes in wood or metal

C. Concrete tools

1. Used for cutting into and through concrete
2. Hammer drills make holes in concrete by "hammering" the rotating bit
3. Air hammers are used to break up large sections of concrete and to make large holes
4. Circular saws (abrasive wheels) are used to cut openings for pipes in concrete walls, floors, and ceilings

D. Threading machines

1. Used for cutting threads to save time and energy
2. Especially helpful on large jobs where a great deal of thread cutting is required
3. Threading machines are necessary for cutting threads on pipe larger than 2"

4. Threading machines usually cut, ream, and thread pipe

E. Sewer and drain cleaning equipment

1. Hand held drain cleaning machines are used to clean out obstructions in waste pipes

2. Power sewer cleaners are designed to clean out soil and sewer pipes with powerful motors and long, strong cables

IV. Safety precautions

A. Know the tool you are using, its application, limitations, and potential hazards

B. Select proper tool for the job

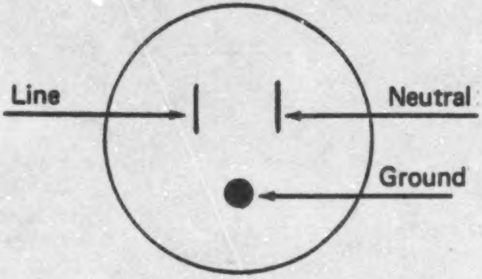
1. Don't try to tackle a big job with an undersized tool

2. Makeshift tools can cause accidents

C. Ground all tools unless double insulated

1. Three-prong plug should be plugged into a three-hole electrical receptacle (Figure 1)

FIGURE 1



2. If adapter is used to accomodate two-prong receptacle, the adapter wire must be attached to a known ground

(CAUTION: Never remove the ground plug from your cord.)

D. Remove adjusting keys and wrenches before turning on tool

E. Keep work area free of clutter

(NOTE: Boards, boxes, debris, and tools, can be tripping hazards.)

F. Keep guards in place and in working order

1. Do not remove

2. Do not wedge out of the way

INFORMATION SHEET

G. Always be alert to potential hazards in your working environment

  1. Be very cautious of damp locations when working with electricity

  2. Be aware of the presence of highly combustible materials such as gasoline and naptha

H. Avoid accidental startup

  1. Make sure switch is off before plugging in cord

  2. Turn power switch off when power is interrupted

  (NOTE: Don't carry plugged in tool with finger on switch.)

I. Make sure saw blades, drill bits, and cutters are sharp, clean, and regularly maintained

J. Use only accessories recommended by the manufacturer

K. Do not force tool

(NOTE: It will do a better and safer job at its designed speed.)

L. Wear safety glasses

(NOTE: Also use face or dust mask if operation requires it.)

M. Do not overreach

(NOTE: Keep proper footing and balance at all times.)

N. Never leave tool running unattended

  1. Don't leave until it comes to a complete stop

  2. Don't leave until it is disconnected from power source

  3. Don't remove drill or bit until machine has stopped running

O. Don't surprise or touch anyone operating a power tool

(NOTE: The distraction could cause a serious accident.)

P. Never adjust, change bits, blades, or cutters with tool connected to power

Q. Dress properly

  1. Avoid loose clothing that could catch in moving parts

2. Wear rubber boots in damp locations

3. Gloves can be caught by revolving machinery

R. Secure work

(NOTE: Using clamps or vise to hold work when practical frees both hands to operate tool.)

S. Do not use tool with frayed cord

(NOTE: Return frayed cords for servicing. Use only heavy duty U.L. listed extension cords of proper wire size and length.)

T. Never brush away chips or sawdust while tool is operating

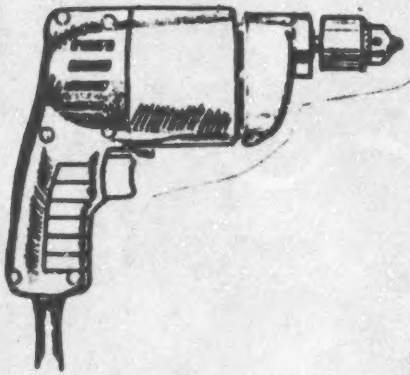
U. Do not attempt field repairs

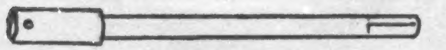
(NOTE: Return for servicing any tool that shows slightest defect or is not operating properly.)

V. Store tools in dry, secure location where they won't be tampered with or stolen

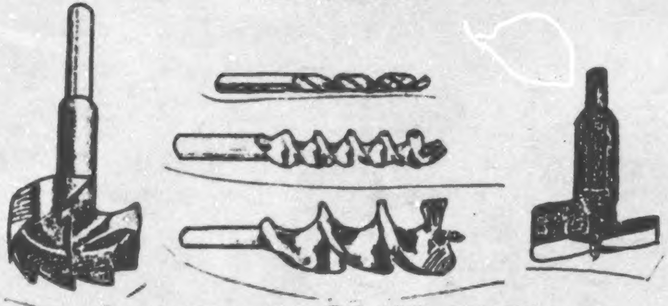
Drilling Machines

¼" Electric Drill

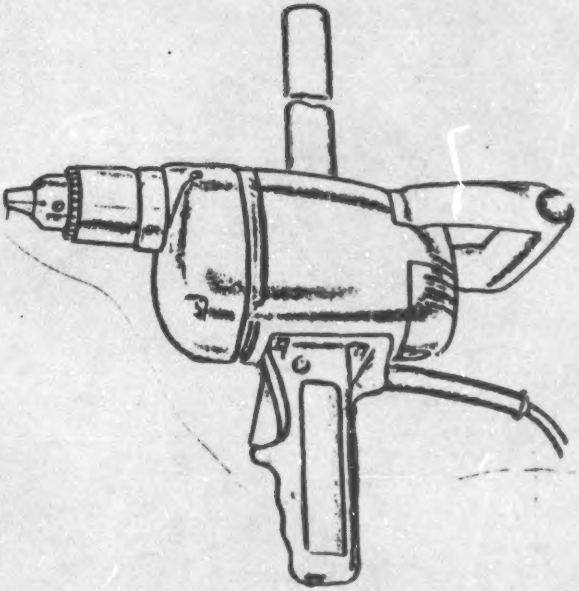




Extension

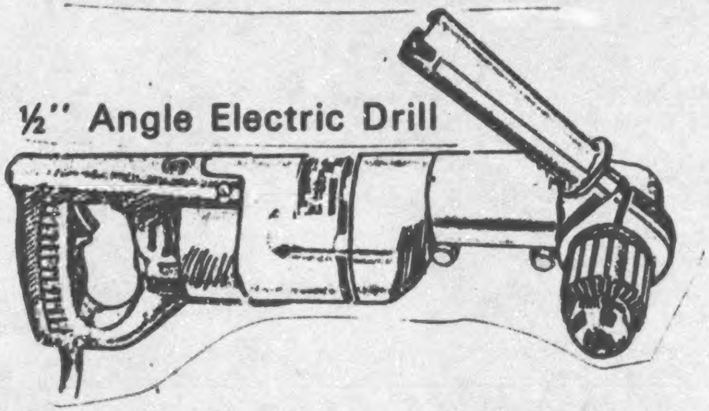


Assortment Of Wood Bits



½" Straight Drill

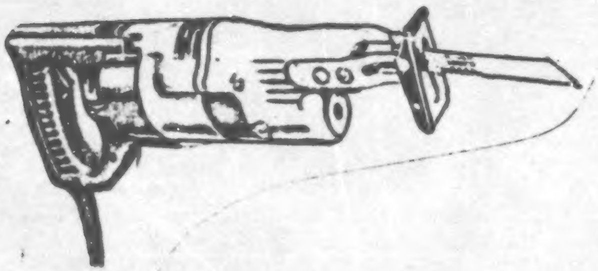
½" Angle Electric Drill

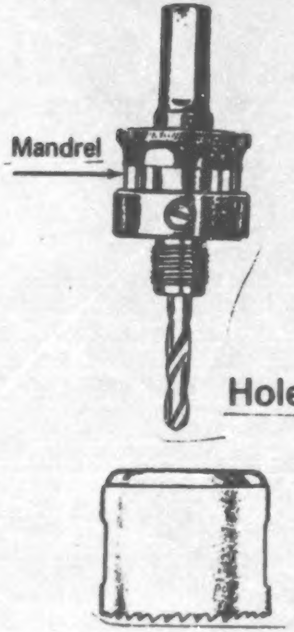


Illustrations of 1/4" electric drill, 1/2" angle electric drill, and assortment of wood bits courtesy of Milwaukee Tool Company.

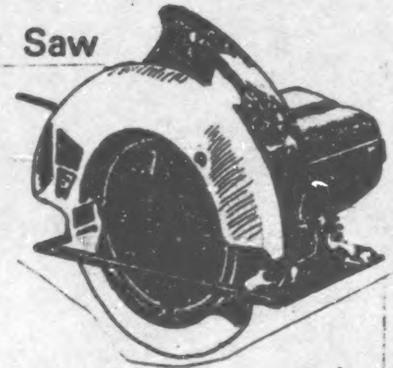
Illustration of 1/2" straight electric drill courtesy of Stanley Tool Company.

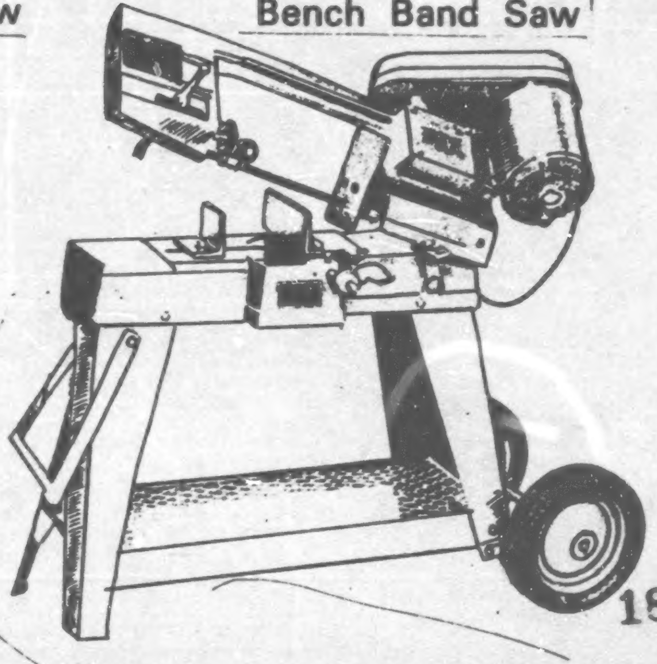
Saws

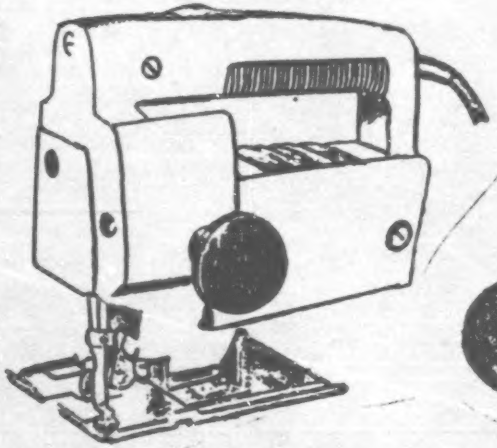

Portable Electric Saw

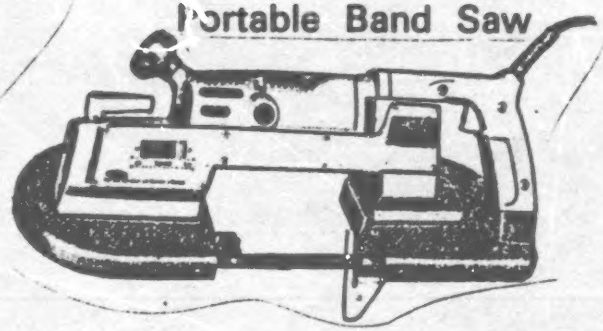


Hole Saw

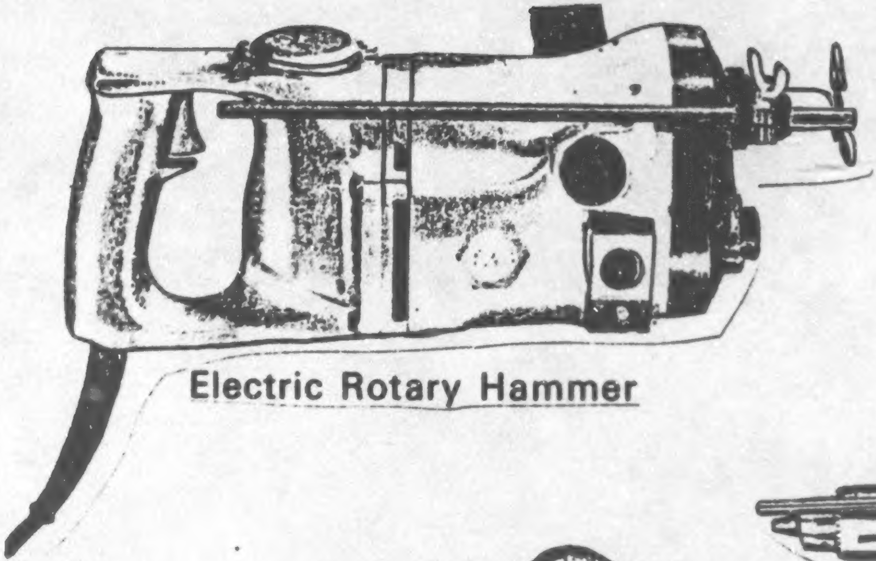

Circular Saw


Bench Band Saw

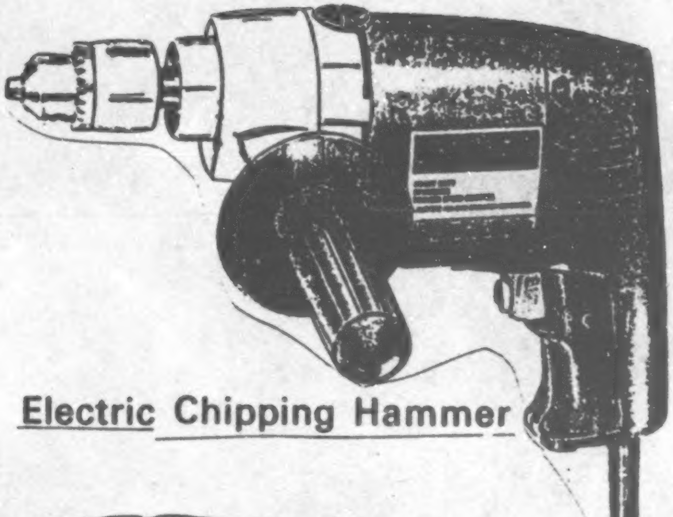

Sabre Saw


Portable Band Saw

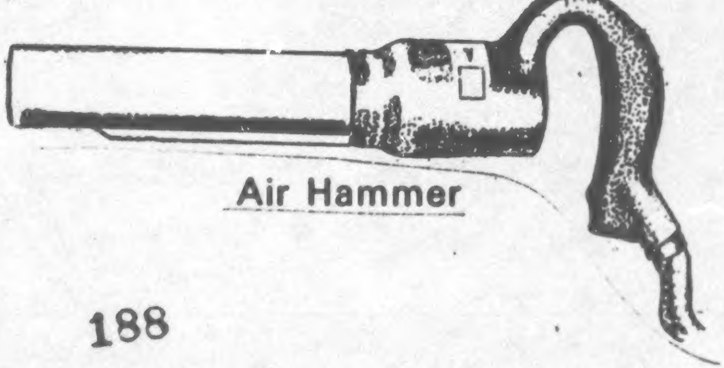
Concrete Tools



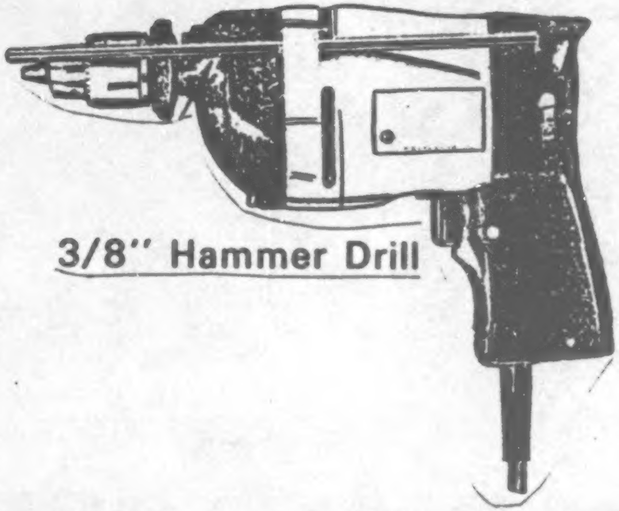
Electric Rotary Hammer



Electric Chipping Hammer

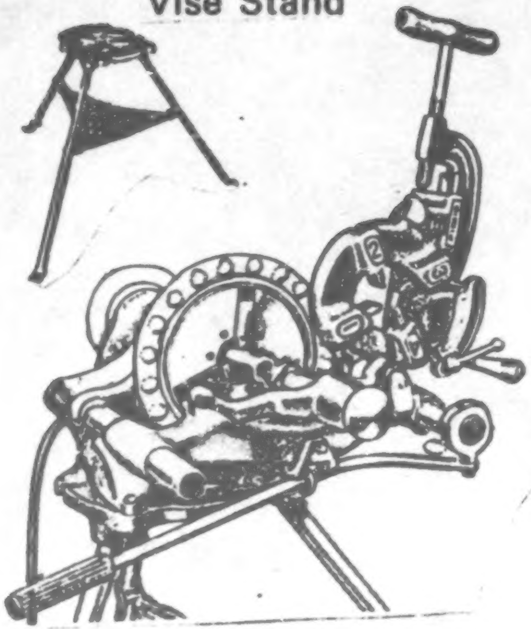


Air Hammer



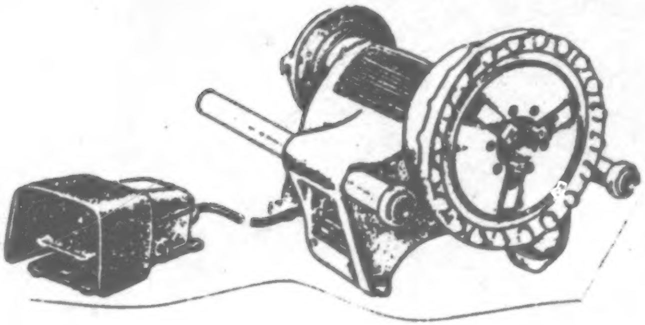
3/8" Hammer Drill

Threading Machines

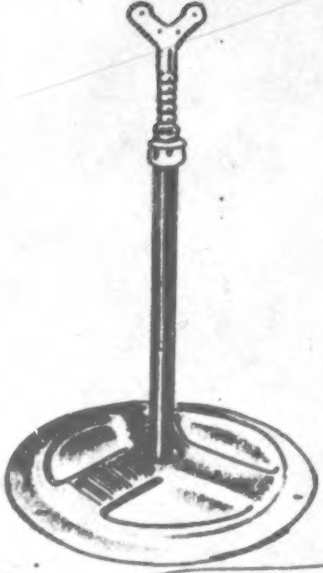


Vise Stand

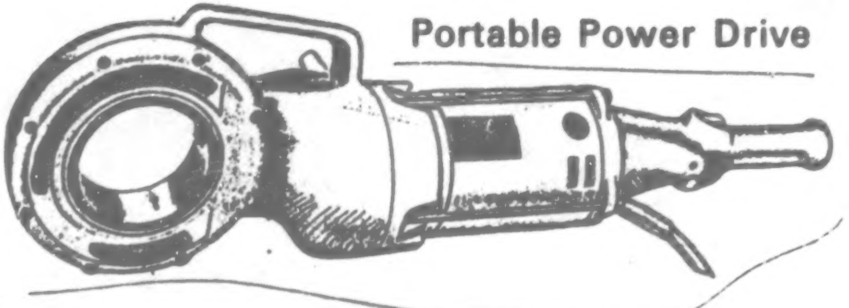
Portable Electric Pipe Threader



Portable Power Driven Vise Stand

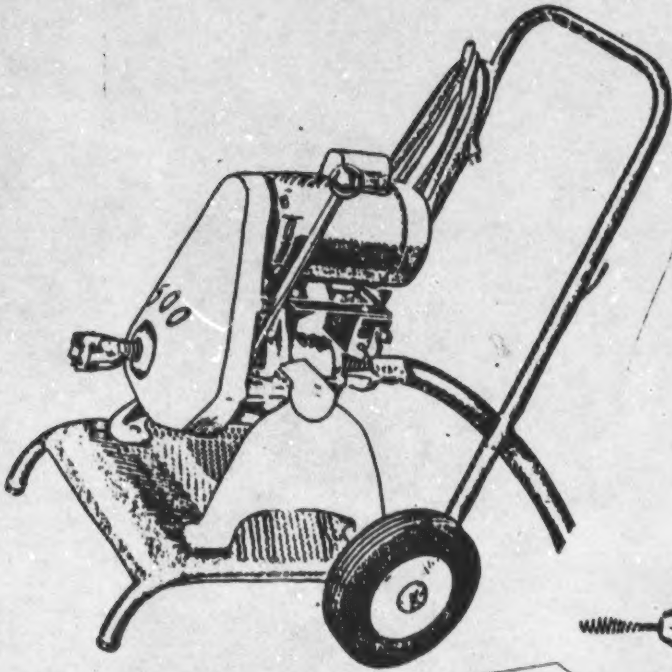


Pipe Support

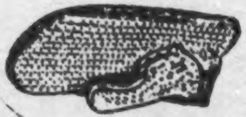


Portable Power Drive

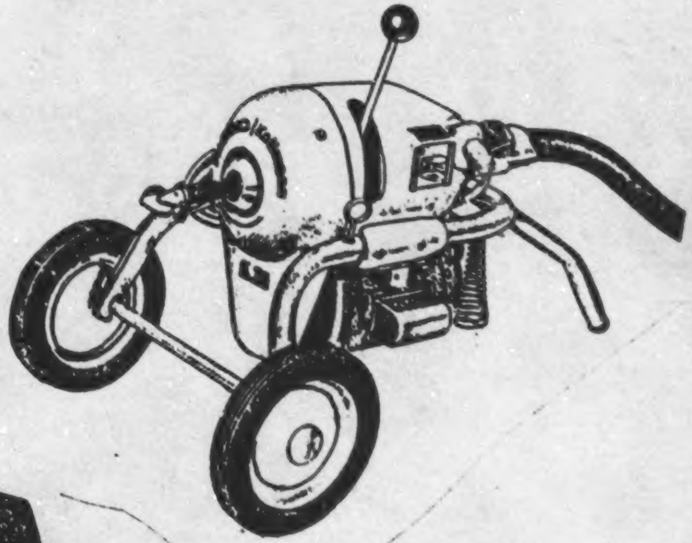
Sewer and Drain Cleaning Equipment



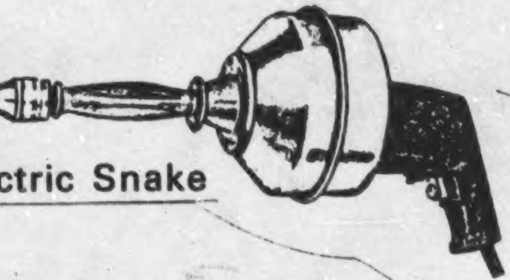
Compressed Air or Gasoline Power Drain Cleaner



Glove



Electric Power Drain Cleaner



Electric Snake

JOB SHEET #1--INSTALL A LAVATORY HANGER ON A CONCRETE WALL

EVALUATION: Given access to tools, equipment, and materials, install a lavatory hanger on a concrete wall. The job will be evaluated by the instructor for levelness, accuracy of placement and rigidity of installation.

I. Tools and materials

   A. Lavatory
   B. Lavatory hanger
   C. Rough-in book
   D. Seven anchor bolts (3/8" x 1-1/2")
   E. Drilling machine, 3/8"
   F. Masonry drill, 3/8"
   G. Straight screwdriver, medium
   H. 6' rule or tape
   I. Pencil
   J. Electrical extension cord
   K. Seven 3/8" steel washers
   L. Level

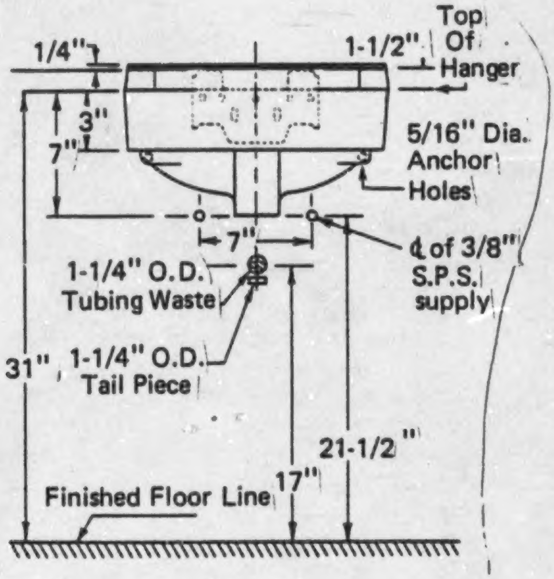
II. Procedure

   A. Gather all the tools and materials and carry to the job site

B. Study the rough-in book and determine height of the lavatory hanger installation (Figure 1)

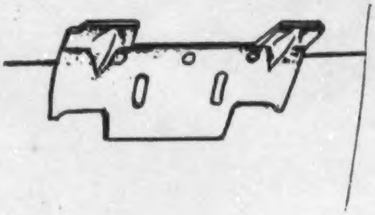
(NOTE: Elongated holes in hanger allow for moving the hanger up or down about 1/2 inch.)

Figure 1


1/4"
1-1/2"
Top Of Hanger
3"
7"
5/16" Dia. Anchor Holes
7"
℄ of 3/8" S.P.S. supply
1-1/4" O.D. Tubing Waste
31"
1-1/4" O.D. Tail Piece
21-1/2"
17"
Finished Floor Line

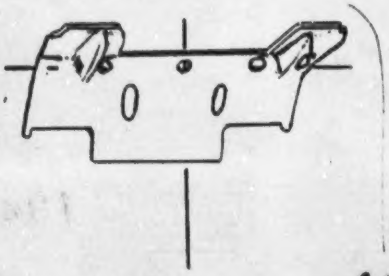
C. Mark the wall (horizontally) where the hanger is to be installed (Figure 2)

FIGURE 2



D. Determine vertical location and mark the wall (Figure 3)

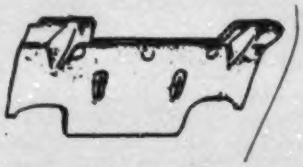
FIGURE 3



E. Hold the hanger on the wall, over the marks and mark location of bolt holes for elongated holes (Figure 4)

(NOTE: Center the bolt hole mark.)

FIGURE 4



F. Place the masonry drill in the drilling machine and tighten the chuck

G. Connect drilling machine to electric outlet using extension cord, if necessary

H. Drill bolt holes for the elongated holes in the hanger

(NOTE: Drill hole 1/4" longer than anchor bolt.)

I. Push anchors into bolt holes

(NOTE: The anchor should be flush with the hole opening.)

J. Place the lavatory hanger on the bolt holes and insert the two screws with washers into the anchors

(NOTE: Place level on hanger and adjust accordingly.)

K. Tighten the two screws and place the lavatory on the hanger

L. Check for correct height

(NOTE: Rim height should be 31".)

M. Adjust hanger height if necessary

(NOTE: Loosen anchor bolts if an adjustment is to be made.)

N. Drill the remaining holes with the hanger bolted in the correct position

(NOTE: Level all work as the job progresses.)

O. Place lavatory on hanger and make final check for height and level

P. Replace all tools and equipment and clean up the area

JOB SHEET #2--CUT OUT A BATHTUB DRAIN OPENING IN A PLYWOOD FLOOR

> EVALUATION: Given access to tools, equipment, and materials, cut out a bathtub drain opening in a plywood floor. The instructor will evaluate the job for neatness and accuracy of cut.

II. Tools and equipment

- A. Reciprocating power saw
- B. Short, pointed wood cutting blade
- C. Electrical extension cord
- D. 6' rule
- E. Pencil

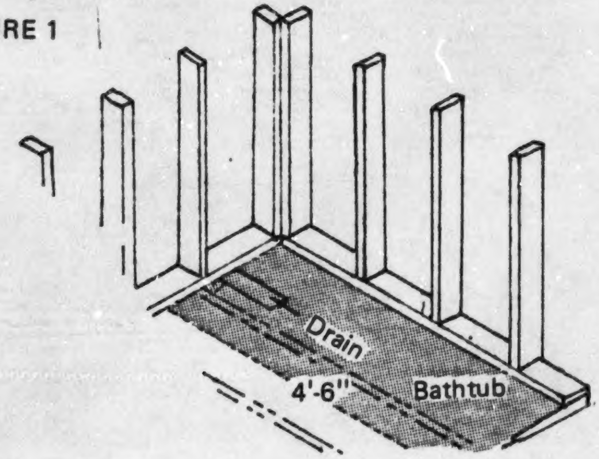
II. Procedure

(NOTE: Simulate a bathroom floor in the lab.)

- A. Gather all tools and equipment and carry to the job site
- B. Mark out location of bathtub drain (Figure 1)

  (NOTE: Usually a 10" x 5" hole is cut. Check for floor joists and other hidden objects.)

FIGURE 1



P-113-R

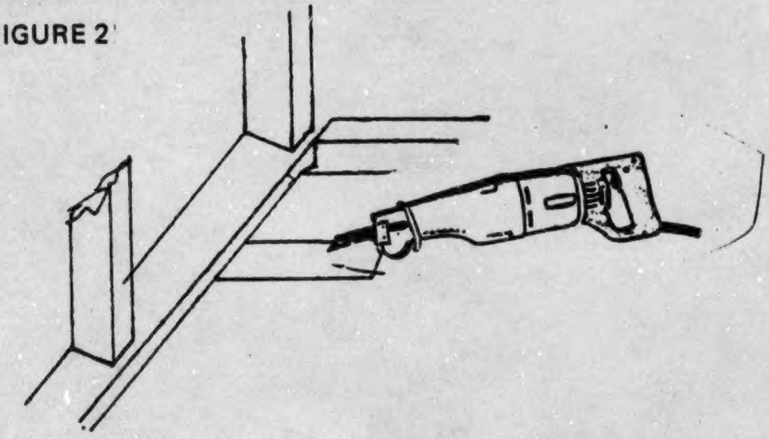
C. Install correct blade in saw

(NOTE: Make sure blade is tight and in correct position.)

D. Connect saw to source of power

E. Hold the saw low and start the cut in the center of the marked out area (Figure 2)

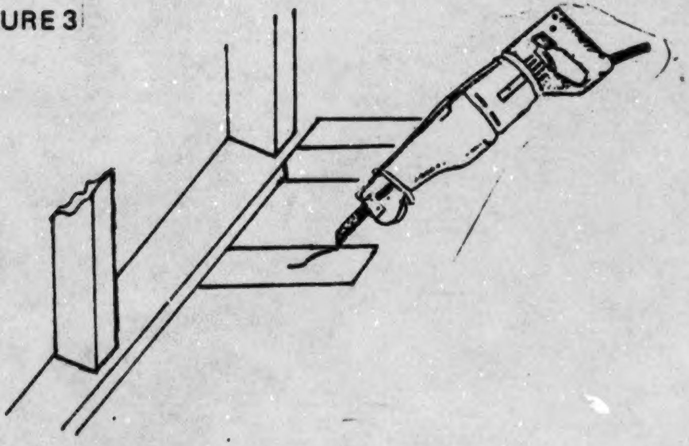
FIGURE 2



F. Press the moving blade down and penetrate the plywood, gradually bringing the saw from horizontal to near vertical position

G. Cut to the line and follow the line around the entire rectangle (Figure 3)

FIGURE 3



H. Remove blade from saw

I. Return all tools and clean up area

JOB SHEET #3--THREAD STEEL PIPE WITH A PORTABLE POWER-DRIVEN VISE STAND

EVALUATION: Using a portable power-driven vise stand, cut thread, and ream one end of a 2" diameter steel pipe. The completed threads must be free of nicks and burrs.

I. Tools and equipment

   A. Portable power driven vise stand

   B. Clean cloth

   C. Safety glasses

   D. Pipe

   E. Pipe cutter

   F. Oil can and cutting oil

II. Procedure

   A. Insert pipe into chuck and tighten

   B. Place cutter on pipe and allow handle of cutter to rest against either one or both bars as required

   C. Start machine and control cutting action of cutter through handle

   D. Ream pipe in similar manner

   E. Stop machine

   F. Start 2 or 3 threads on pipe by hand with ratchet-type dies

   G. Start machine and cut required number of threads, keeping oil on die stock until appropriate threads are cut

   H. Stop machine, push bars back, and remove dies from pipe by hand

   I. Check with instructor for evaluation of job

   J. Clean up area and return tools and equipment

POWER TOOLS
UNIT II

NAME ____________________

TEST

1. Match the terms on the right to the correct definitions.

_____a. Tools operated with electricity, air, or gasoline

_____b. Tools which are hand held and are not operated by electricity, air, or gasoline

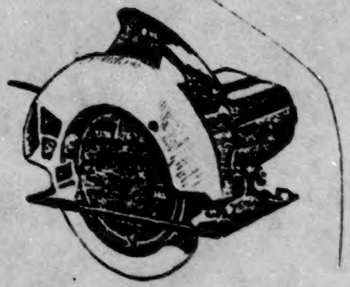
_____c. Tools, both hand and power, used to install the initial stage of the building's plumbing, including cutting and drilling access holes, and connecting piping

_____d. Moving in a back and forth motion, as opposed to a circular motion

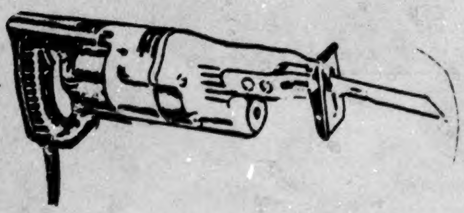
_____e. Cutting and grinding of material by a thin wheel made of a hard stone-like substance

1. Hand tools
2. Reciprocating
3. Power tools
4. Abrasive
5. Roughing-in tools

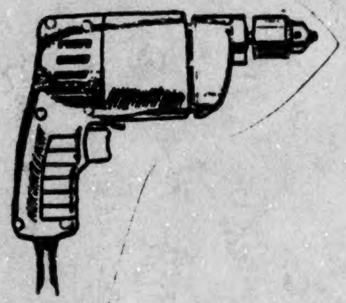
2. Identify power tools generally used in residential plumbing.

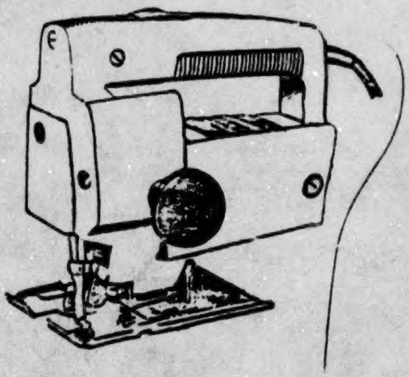


a. ____________________



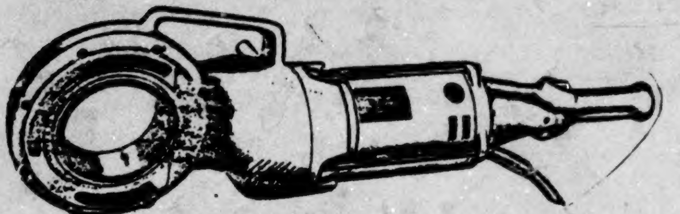
b. ____________________

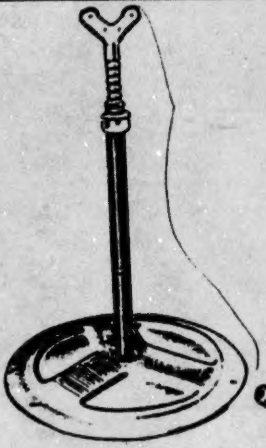




c. ______________________________

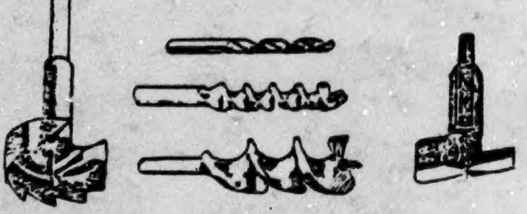
d. ______________________________

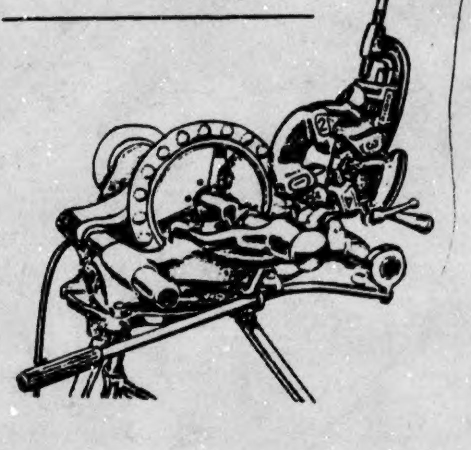




e. ______________________________

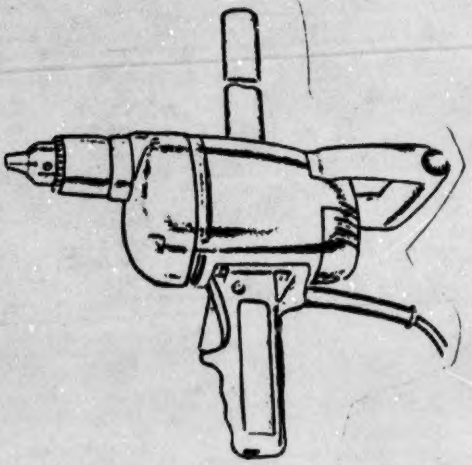
f. ______________________________

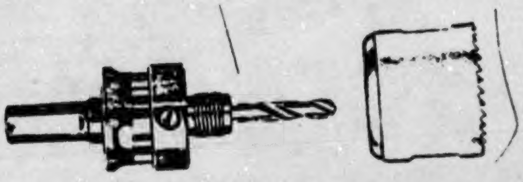




g. ______________________________

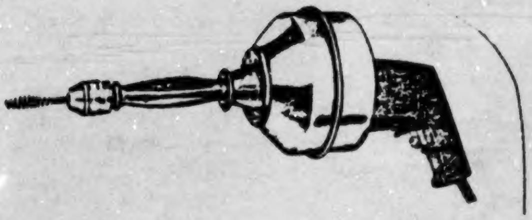
h. ______________________________

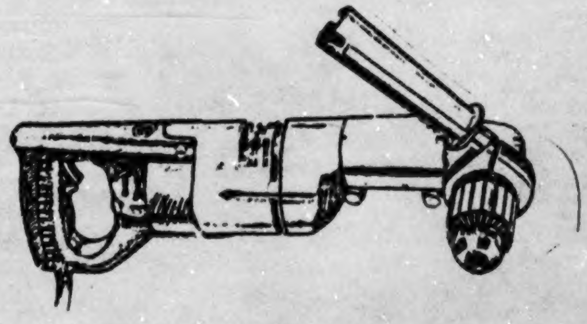




i. ______________________

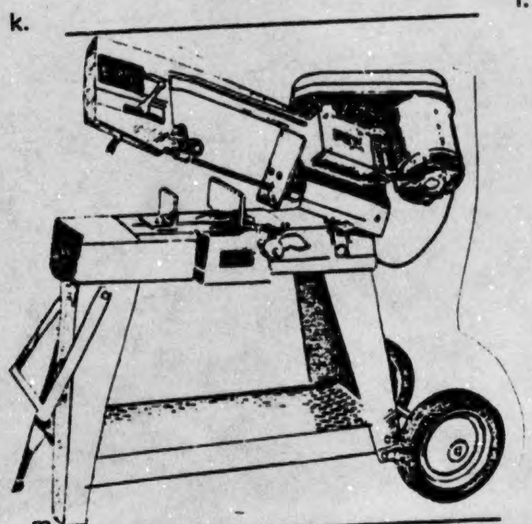
j. ______________________

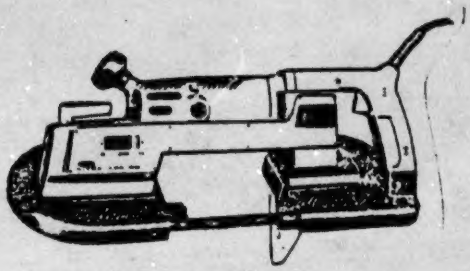




k. ______________________

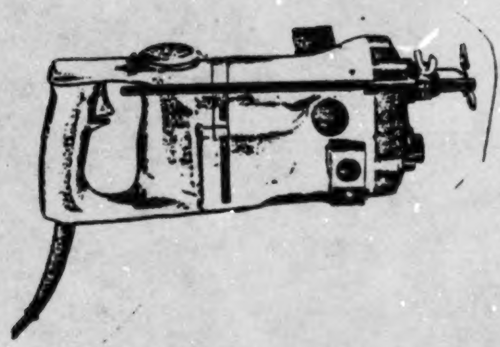
l. ______________________



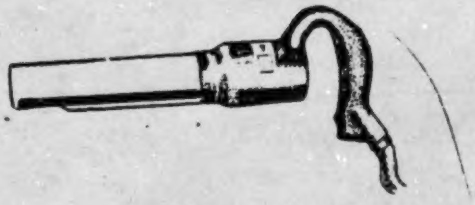


m. ______________________

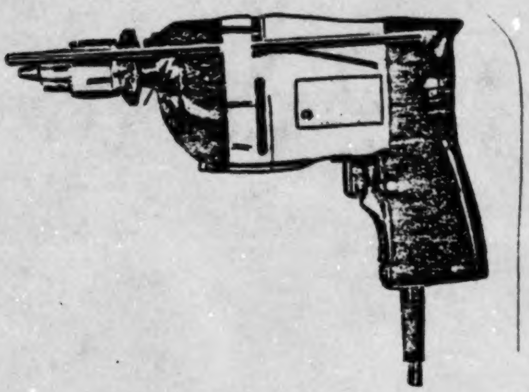
n. ______________________



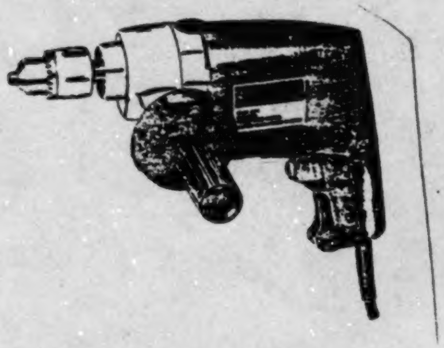
o. ______________________



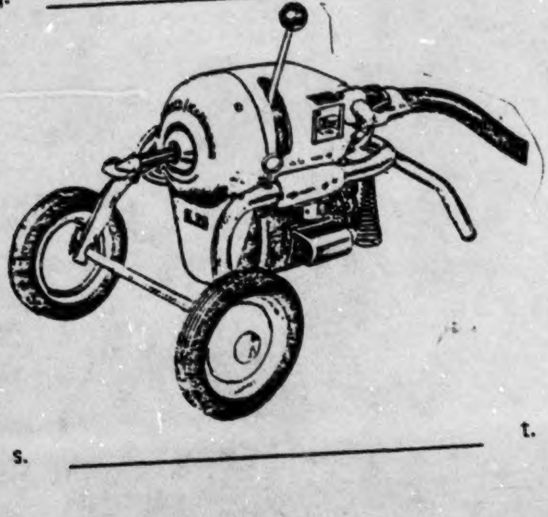
p. ______________________



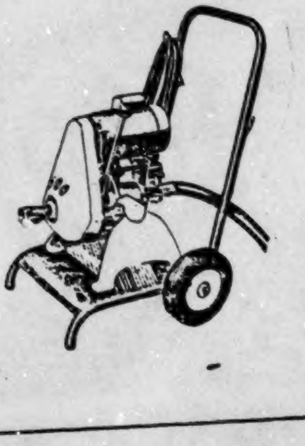
q. ______________________



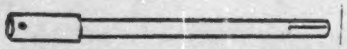
r. ______________________

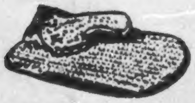


s. ______________________

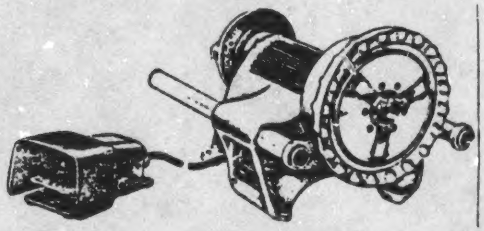


t. ______________________





u. ______________________________ v. ______________________________



w. ______________________________

3. Discuss the use and care of power tools used in residential plumbing.

   a. Drilling machines

   b. Saws

   c. Concrete tools

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d. Threading machines

e. Sewer and drain cleaning machines

4. List 10 safety precautions to be applied in the use of power tools used in residential plumbing.

   a.

   b.

   c.

   d.

   e.

   f.

   g.

   h.

   i.

   j.

5. Demonstrate the ability to:

   a. Install a lavatory hanger on a concrete wall.

   b. Cut out a bathtub drain opening in a plywood floor.

   c. Thread steel pipe with power-driven vise stand.

   (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 5
   d. 2
   e. 4
2. a. Circular saw
   b. Portable electric saw
   c. 1/4" electric drill
   d. Sabre saw
   e. Portable power drive
   f. Pipe support
   g. Assortment of wood bits
   h. Portable electric pipe threader
   i. 1/2" straight electric drill
   j. Hole saw
   k. Electric snake
   l. 1/2" angle electric drill
   m. Bench band saw
   n. Portable band saw
   o. Electric rotary hammer
   p. Air hammer
   q. 3/8" hammer drill
   r. Electric chipping hammer

s. Electric power drain cleaner

t. Compressed air or gasoline power drain cleaner

u. Extension

v. Glove

w. Portable power driven vise stand

3. Discussion should include:

   a. Drilling machines

      1. Small drills (1/4") develop more R.P.M.'s than large drills because the larger units are designed to turn larger cutting tools or to drill in heavy materials, and both of these factors require a slower speed

      2. The chuck key should be strapped to the power cord

      3. The cutting tool must be kept sharp in order to avoid forcing the machine and causing unnacessary wear and short life

      4. Drilling machines should be kept in the storage box when not in use in order to avoid damage

   b. Saws

      1. Saw blades should be kept sharp in order to avoid excessive forcing of the machine

      2. Portable electric circular saws are used for cutting lumber, but can be fitted with abrasive wheels to cut metal and concrete

      3. Power saws should be operated at a limited speed of cut in order to avoid blade breakage

      4. Reciprocating power saws are often used for cutting irregular shaped pipe holes and openings especially in difficult to-get-at places

      5. Small reciprocating power saws (saber saws) are helpful in cutting out countertops for kitchen sinks

      6. Hole saws cut holes in wood or metal

   c. Concrete tools

      1. Used for cutting into and through concrete

      2. Hammer drills make holes in concrete by "hammering" the rotating bit

      3. Air hammers are used to break up large sections of concrete and to make large holes

EQUIPMENT
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify the equipment used in the residential plumbing trade. The student should also be able to match correct use and care statements to a specific piece of equipment and list safety rules for operating an air-acetylene torch outfit. This knowledge will be evidenced by correctly performing the procedures outlined on the job sheets and by scoring 85 percent on the unit test.

(NOTE: The student must score one hundred percent on the safety section of the test.)

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with equipment to correct descriptions and definitions.
2. Identify equipment generally used in residential plumbing.
3. Match types of equipment to the correct use and care statements.
4. List safety precautions related to operating an air-acetylene torch outfit.
5. Demonstrate the ability to:
    - a. Light and adjust the air-acetylene torch.
    - b. Set up and adjust the builder's level.
    - c. Set up and light a propane furnace.
    - d. Set up an inflatable rubber test plug in a pipe.
    - e. Set up a mechanical test plug in a pipe.
    - f. Set up and operate a ratchet lever hoist.
    - g. Grind a flat tip screwdriver.
    - h. Grind the head of a cold chisel or punch
    - i. Sharpen a cold chisel.

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EQUIPMENT
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide student with objective sheet.
- B. Provide student with information and job sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information sheet.
- F. Demonstrate and discuss the procedures outlined in the job sheets.
- G. Arrange for manufacturer's representative to address the class.
- H. Give a safety talk on gas and gas equipment
- I. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete job sheets.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
    1. TM 1--Test Equipment
    2. TM 2 --Air-Acetylene Torch Outfit
    3. TM 3 --Air-Acetylene Torch Outfit (Continued)

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    4. TM 4--Air-Propane Torch Outfit
    5. TM 5--Air-Propane Torch Outfit (Continued)
    6. TM 6--Furnace Equipment
    7. TM 7--Ladders
    8. TM 8-- Site Layout and Measuring Tools
    9. TM 9--Hoists, Dolly, and Hand Truck
    10. TM 10--Cleaning and Excavating Equipment
    11. TM 11--Excavating Equipment
    12. TM 12--Cast Iron Pipe Assembly Tools
    13. TM 13--Wrenches
    14. TM 14--Pipe Cutting Equipment
    15. TM 15--Cast Iron Pipe Cutters

D. Job sheets

    1. Job Sheet #1--Light and Adjust the Air-Acetylene Torch
    2. Job Sheet #2--Set Up and Adjust the Builder's Level
    3. Job Sheet #3--Set Up and Light a Propane Furnace
    4. Job Sheet #4--Set Up an Inflatable Rubber Test Plug in a Pipe
    5. Job Sheet #5--Set Up a Mechanical Test Plug in a Pipe
    6. Job Sheet #6--Set Up and Operate a Ratchet Lever Hoist
    7. Job Sheet #7--Grind a Flat Tip Screwdriver
    8. Job Sheet #8--Grind the Head of a Cold Chisel or Punch
    9. Job Sheet #9--Sharpen a Cold Chisel

E. Test

F. Answers to test

II. References:

A. Blayton, Joseph W. *Plumbing Apprentice Training.* Washington, DC: Joint Apprentice Test, 1951.

B. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, Il: Goodheart-Willcox Co., Inc., 1978.

EQUIPMENT
UNIT III

INFORMATION SHEET

I. Terms and definitions

   A. Propane--A heavy, flammable, gaseous, paraffin hydrocarbon found in crude petroleum and natural gas and used as a fuel

   B. Torch--Tool used to create a controlled flame which is used for soldering copper fittings

   C. Acetylene--A colorless, gaseous hydrocarbon made by the action of water on calcium carbide and used as a fuel

   D. Test--Isolating a piping system with plugs of various types and applying air pressure, water, smoke or other agents in order to check for leaks in the system

   E. Hoist--Instrument used to lift heavy objects with the least amount of strain on the worker

   F. Optical instruments--Instruments used to determine grade when installing long lengths of pipe

   G. Trench--Excavation made for the installation of pipe

   H. Bench grinder--Electric powered grinding wheel used to sharpen tools and wear away excess metal from various objects

II. Equipment generally used in residential plumbing

   A. Test equipment (Transparency 1)

      1. Mechanical test plug

      2. Inflatable rubber test plug

      3. Tire pump

      4. Test gauge assembly

      5. Test caps

      6. Manometer

INFORMATION SHEET

B. Torches

1. Air-acetylene torch outfit (Transparencies 2 and 3)
    a. Acetylene tanks
        1) "MC" acetylene tank
        2) "B" acetylene tank
    b. Torch handle
    c. Hose
    d. Regulator
    e. High temperature wraparound flame tip
    f. Tips
    g. Halide torch leak detector
    h. Striker
    i. Cylinder wrench
2. Air-propane torch outfit (Transparencies 4 and 5)
    a. Propane tanks
        1) Liquified petroleum cylinder, 20 lbs. capacity
        2) Liquified petroleum cylinder, 2-1/2 lbs. capacity
    b. Torch handle
    c. Regulator
    d. High temperature wraparound flame tip
    e. Standard tips
    f. Halide torch leak detector
    g. Striker
    h. Hose
    i. Tank key

INFORMATION SHEET

C. Furnace equipment (Transparency 6)
   1. Propane furnace
   2. Lead ladle
   3. Lead pot
   4. Joint runner

D. Ladders (Transparency 7)
   1. Stepladder
   2. Single ladder
   3. Extension ladder
   4. Scaffolding

E. Site layout and measuring tools (Transparency 8)
   1. Builder's level
   2. Hand level
   3. 100' steel tape
   4. Chalk line and reel
   5. Plumb bob
   6. Rubber hose

F. Hoists (Transparency 9)
   1. Hand chain hoist
   2. Ratchet lever hoist
   3. Ropes and slings
   4. Gin block

G. Dollies and hand trucks (Transparency 9)
   1. Dolly
   2. Hand truck

INFORMATION SHEET

H. Cleaning equipment (Transparency 10)

   1. Bench brush

   2. Push broom

   3. Hand broom

I. Excavating equipment (Transparencies 10 and 11)

   1. Round point shovel

   2. Square point shovel

   3. Sharp shooter shovel

      (NOTE: The above listed shovels are made with long and short handles.)

   4. Power trencher

   5. Backhoe

J. Cast iron pipe assembly tools (Transparency 12)

   1. Pipe puller

   2. Lubricant

   3. Lead hammer

   4. Lubricant brush

K. Wrenches (Transparency 13)

   1. Light duty chain wrench

   2. Heavy duty chain wrench

   3. 24", 36" straight pipe wrenches

L. Pipe cutting equipment (Transparency 14)

   1. Vise stand

   2. Pipe reamers

   3. Wheel pipe cutter

INFORMATION SHEET

M. Cast iron pipe cutters (Transparency 15)

1. Ratchet cutter

2. Squeeze-type cutter

3. Hydraulic cutter

4. Caulking hammer and chisel

III. Use and care of equipment

A. Test equipment (Transparency 1)

1. Mechanical test plugs are used to seal a drainage system or part of a drainage system in order to check for leaks

2. Tire pumps are used to inflate rubber test plugs after they are inserted in the piping system

3. Test gauge assembly is used to attach the air pump to the piping system being tested and to show amount of pressure on a gauge

4. Test caps are used to seal ends of pipes in order to seal the system for a test

5. The manometer is a device used to measure the amount of pressure developed in a piping system being tested

6. Halide torches are used to detect leaks in piping systems

(NOTE: Freon is introduced into the finished plumbing system through the water closet trap and any freon gas that seeps out from a leak is detected because the flame on the halide torch will turn green.)

B. Torches and furnaces (Transparencies 2, 3, 4, 5, and 6)

1. Torches (in residential plumbing) are used to heat copper tube and melt solder to make sweat joints

2. Torch tips must be handled carefully in order to avoid denting and crimping

(NOTE: A damaged tip can cause a faulty flame.)

3. Torches must be kept clean

(NOTE: Molten solder falling onto torch can clog air vents and torch tip.)

P-135-P

4. Torches are used to melt lead from caulked cast iron joints

5. Proper tools must be used to open gas tanks: a "T" wrench for propane tank, a cylinder wrench for acetylene tank

6. Furnaces are used to melt lead for caulking cast iron soil pipe

7. Furances must be kept clean

   (NOTE: Molten lead falling onto furnace can clog air vents and burner orifice.)

8. Furnaces must be handled carefully in order to avoid damage to the burner and gas valve

C. Ladders (Transparency 7)

1. The stepladder is used when working short distances above ordinary reach level

2. Stepladders are handy for climbing in and out of trenches which are 4'-6' deep

   (NOTE: Trenches over 6' deep should be provided with single ladders which extend above the top of the trench.)

3. Single ladders are used to reach the roof of single story buildings

   (NOTE: Legs of single and extension ladders should be secured in order to avoid slipping.)

4. Single ladders are used in new buildings where no staircases have been installed

   (CAUTION: Do not use step ladders to reach areas which necessitate standing on the top step of the ladder.)

5. Extension ladders are used to reach the roof of two story buildings

6. Scaffolds are usually provided by bricklayers, plasterers, and/or painters and are sometimes used by plumbers to reach high places in the building

   (CAUTION: Care should be taken when working on scaffolds as their construction and set-up is not always safe.)

D. Layout and measuring tools (Transparency 8)

1. The builder's level is used by the residential plumbers primarily to determine pitch of long runs of pipe

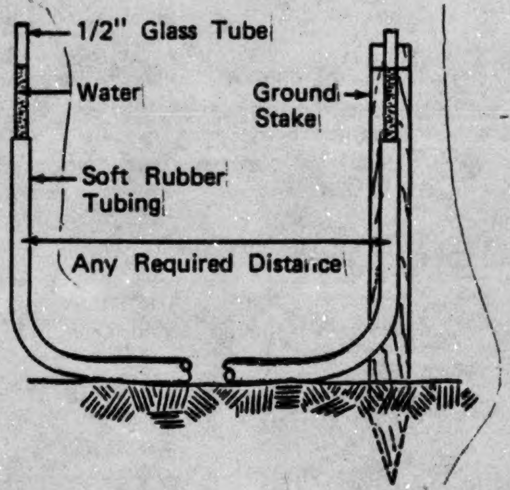
INFORMATION SHEET

2. Since long runs of residential piping are mostly underground installations, trench excavations are usually determined with the use of the builder's level

3. Hand levels are useful for making rough measurements of trench depths

4. A handy way to develop pitch measurement on long runs, when builder's levels are not present, is to use a length of hose (Figure 3)

Figure 3



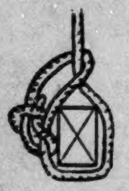
E. Hoists (Transparency 9)

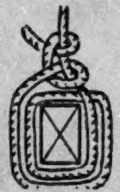
1. Hand chain hoists are used to raise or lower heavy objects or to hold them temporarily in position

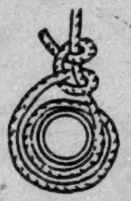
2. A hand chain hoist or ratchet lever hoist will lift or pull heavy loads for short distances

3. Ropes and slings help make lifting easier and help prevent strains and bruises

(NOTE: Use of correct knots prevents slippage and possible accidents.)


Running Bowline


Double Turn
And Two
Half Hitches
Around Beam


Double Turn
And Two
Half Hitches
Around Pipe

P-1E1-4

4. Gin blocks permit light and medium weight objects to be lifted considerable distances with savings of time and energy

F. Dollies and hand trucks (Transparency 9)

1. Dollies can transport heavy objects along level surfaces and slight grades

2. Hand trucks can transport heavy objects over rough ground, up and down stairs, up and down steep grades, and over level surfaces

G. Excavating equipment (Transparencies 10 and 11)

1. Round pointed shovels are used for general digging purposes

2. Square pointed shovels are used for cutting straight lines in grass sod, squaring corners of excavations, and helping to make tunnels under sidewalks, shrubs, driveways or porches

3. Sharp shooter shovels are used to make tunnels under sidewalks, shrubs, driveways, porches, and footings

4. Power trenchers are used to dig narrow and comparatively shallow trenches

(NOTE: These machines are excellent for soils with little or no stones.)

5. Backhoes dig wide (average 18"-24") and deep (average 8'-10') trenches

(NOTE: Backhoes are recommended for use in stoney and hard soils.)

(CAUTION: Power trenchers and backhoes should be operated by experienced equipment operators.)

H. Cast iron pipe assembly tools (Transparency 12)

1. Neoprene gaskets are made in service weight for service weight soil pipe and fittings

2. Assembly tools are used to pull cast iron pipes and fittings together

3. Lead hammers are used to install fittings

INFORMATION SHEET

IV. Safety precautions related to operating an air-acetylene torch outfit

A. Regulator

1. Keep regulator off when not in use
2. Be sure to turn adjustment scraw completely off prior to start up

   (NOTE: Failure to turn screw off may burst the regulator which may cause injury to the operator

3. Inspect all nuts and connections prior to using the regulators
4. Do not force connections of hoses and regulators
5. Use the proper regulator on the proper cylinder
6. Do not exceed recommended pressures
7. Have only skilled mechanics repair faulty regulators

B. Gauges

1. Keep glass protected from breaking
2. Replace any broken gauge glasses
3. Do not attempt to repair a defective gauge

C. Hoses

1. Test hoses for leaks by immersing in water at normal working pressure.

   (NOTE: Leaky hoses should be properly repaired or replaced.)

2. Use only one type of gas in the hose

   (NOTE: A mixture of different gases in the hose could result in an explosion.)

3. Avoid dragging the hose on a greasy floor
4. Avoid circumstances where a hose can be rolled upon, kinked, burned, or subjected to falling objects or hot metals
5. Keep hose connections tight
6. Do not repair a hose with tape

7. Keep the hose properly rolled and stored when not in use

   (NOTE: Spring type hose reels are also available.)

D. Torches

1. Keep all connections to the torch tight

   (NOTE: Test them accordingly.)

2. Any torch suspected of being faulty should be repaired by a competent serviceman

3. Avoid any contact with greasy or oily substances

4. Restrictions in the tip may cause back pressure and leakage

   (NOTE: Handle tips carefully.)

E. Torch tips

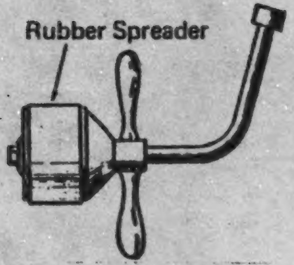
1. Do not remove a tip from the torch when it is hot

   (NOTE: Allow it to cool first.)

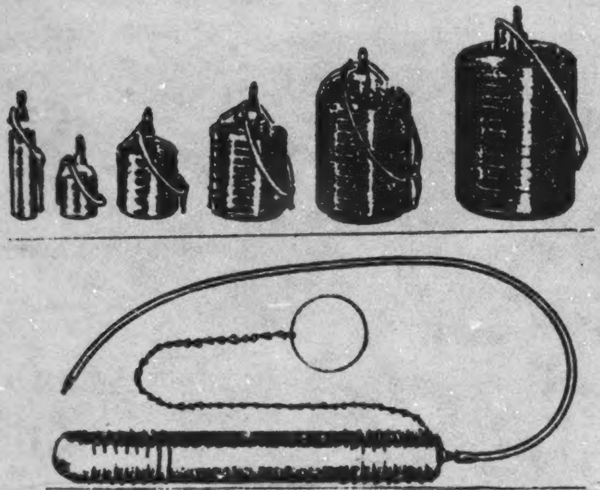
2. Use the manufacturer's wrench to remove the torch tip

   (NOTE: Do not use pliers.)

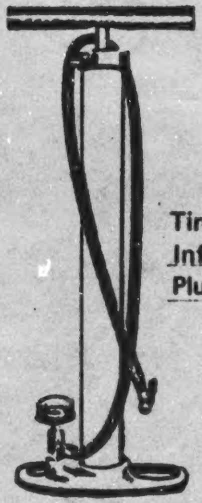
Test Equipment


Rubber Spreader

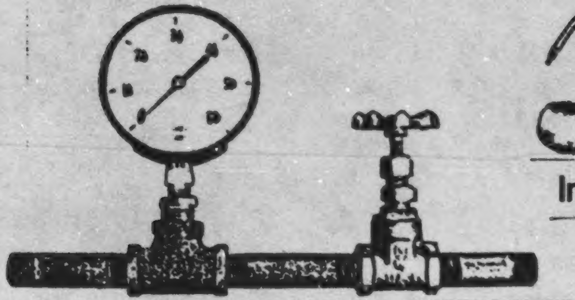
Mechanical Test Plug



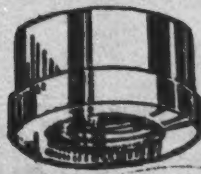
Inflatable Rubber Test Plugs



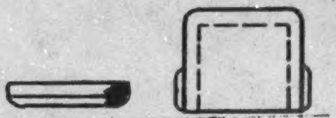
Tire Pump for Inflating Test Plug and Balls



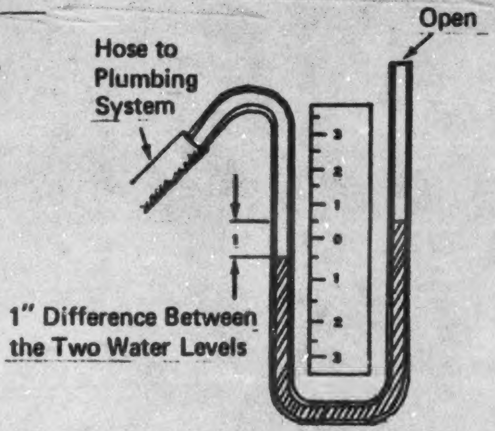
Test gauge assembly



Test Cap for threaded pipe

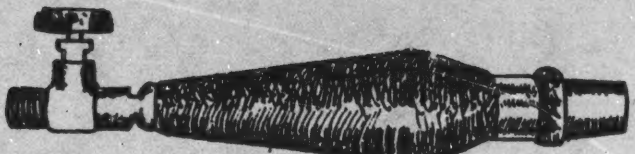

Copper
Plastic

Test Cap for copper or plastic

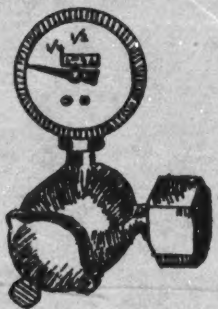

Open
Hose to Plumbing System
1" Difference Between the Two Water Levels
3
2
1
0
1
2
3

Manometer

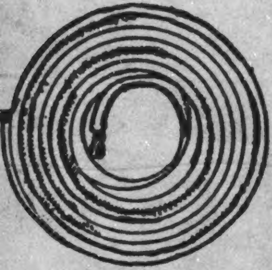
Air-Acetylene Torch Outfit



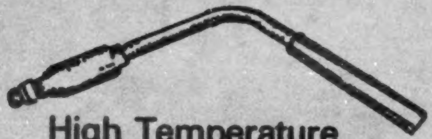
Torch Handle



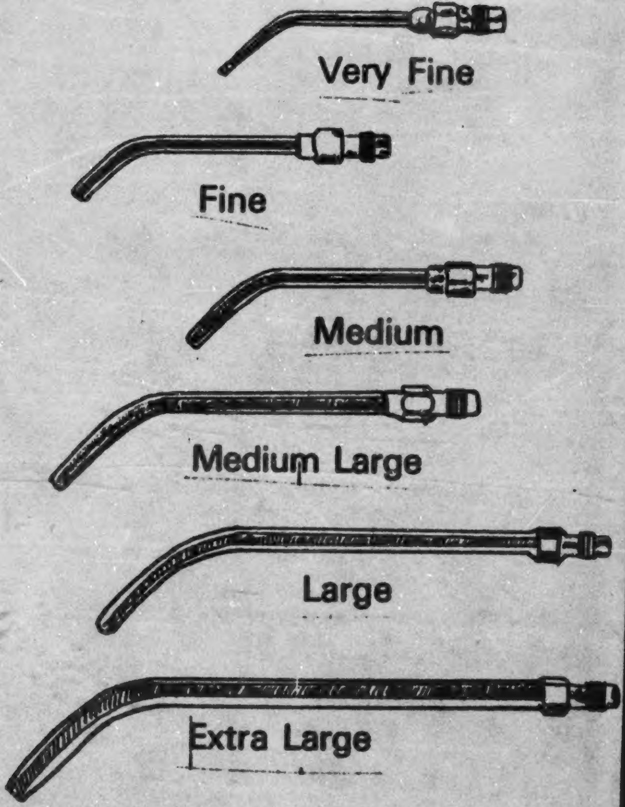
Regulator



Hose



High Temperature
Wraparound Flame Tip



Very Fine

Fine

Medium

Medium Large

Large

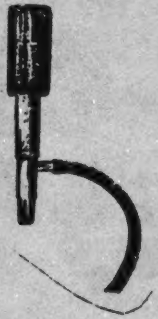
Extra Large

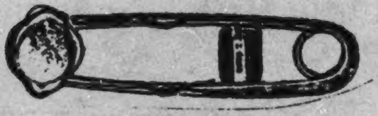
Tips

Air-Acetylene Torch Outfit

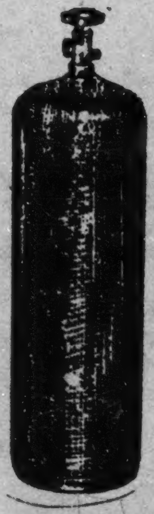
(Continued)

Halide Torch Leak Detector

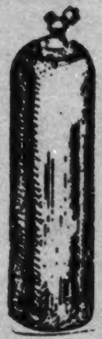




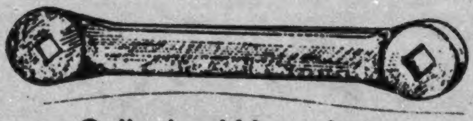
Striker



"B" Acetylene Tank

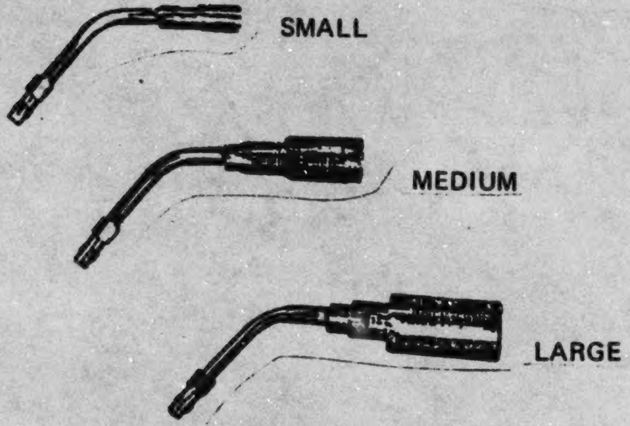


"MC" Acetylene Tank



Cylinder Wrench

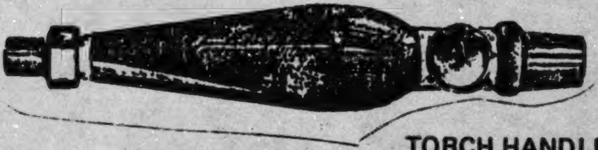
Air-Propane Torch Outfit

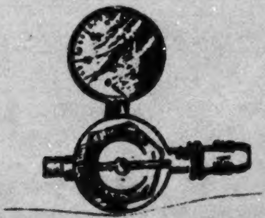

SMALL

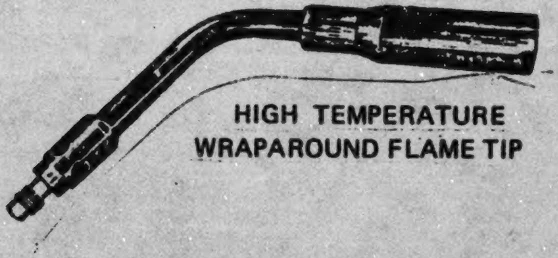
MEDIUM

LARGE

Standard Tips

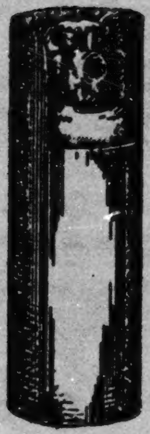

TORCH HANDLE


REGULATOR

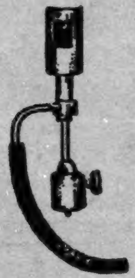

HIGH TEMPERATURE
WRAPAROUND FLAME TIP

Air-Propane Torch Outfit

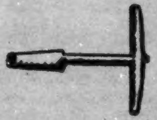
(Continued)



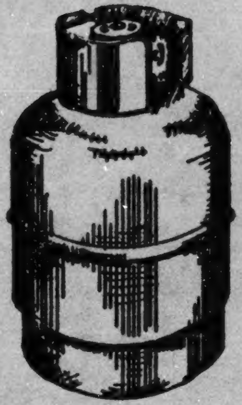
Liquified Petroleum
Cylinder 2 1/2 lb. Capacity



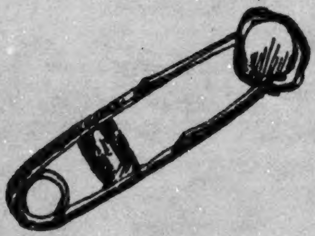
Halide Torch
Leak Detector



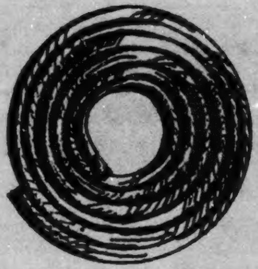
Tank Key



Liquified Petroleum
Cylinder 20 lb. Capacity

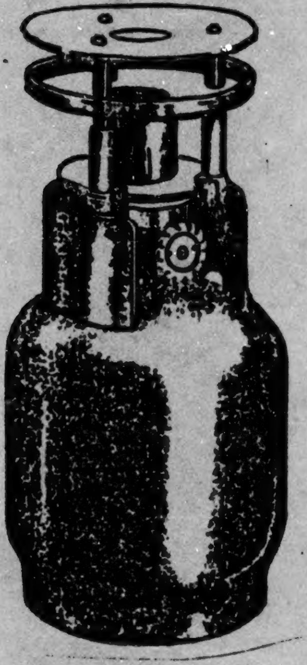


Striker

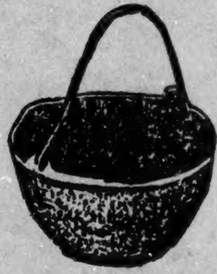


Hose

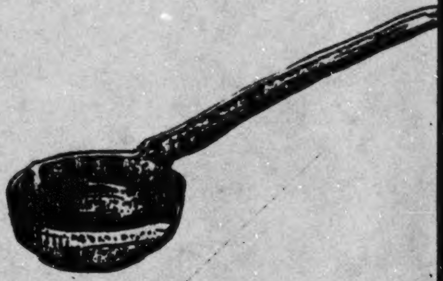
Furnace Equipment



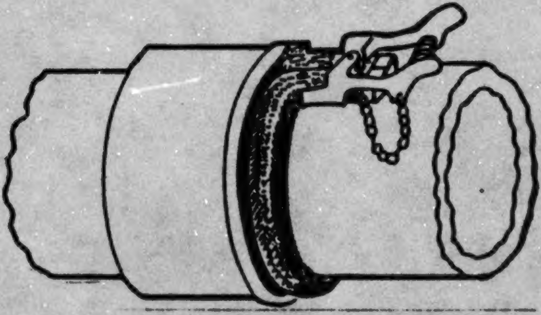
Propane Furnace



Lead Pot



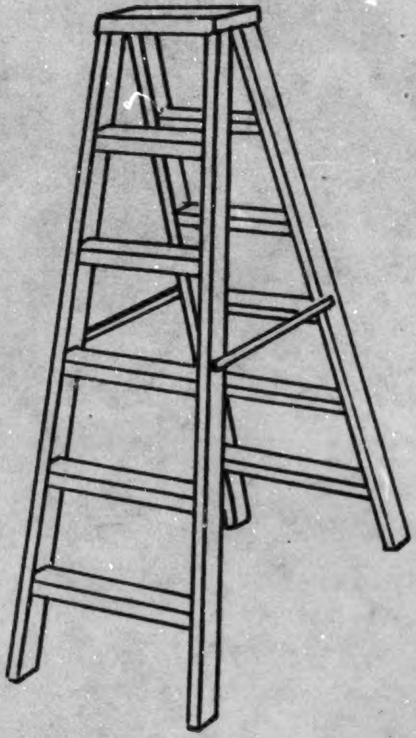
Lead Ladle

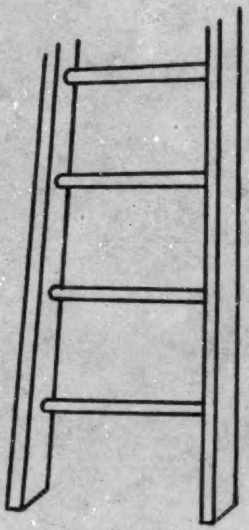


Joint Runner
(Running Rope)

Ladders

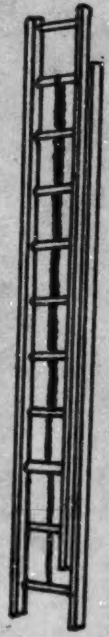
Stepladder

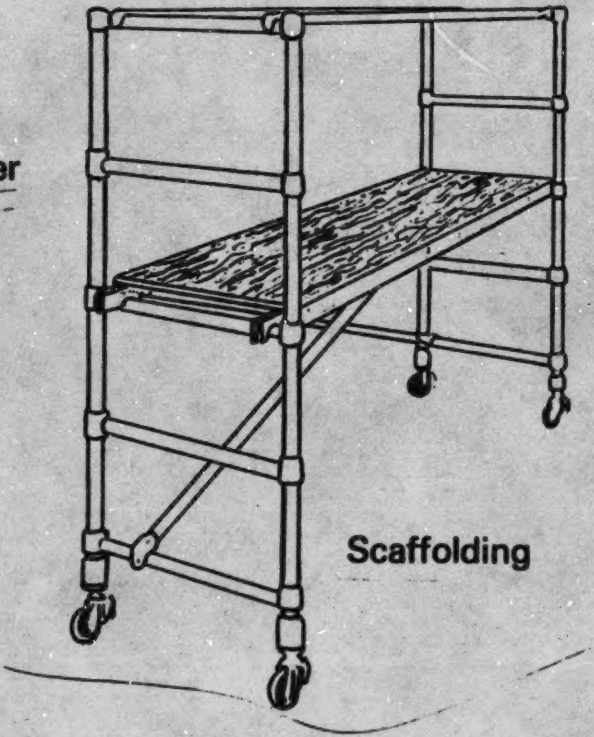




Single Ladder

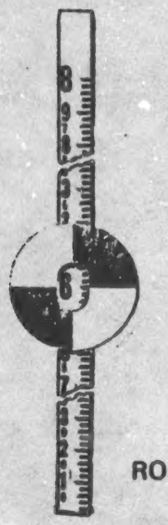
Extension Ladder



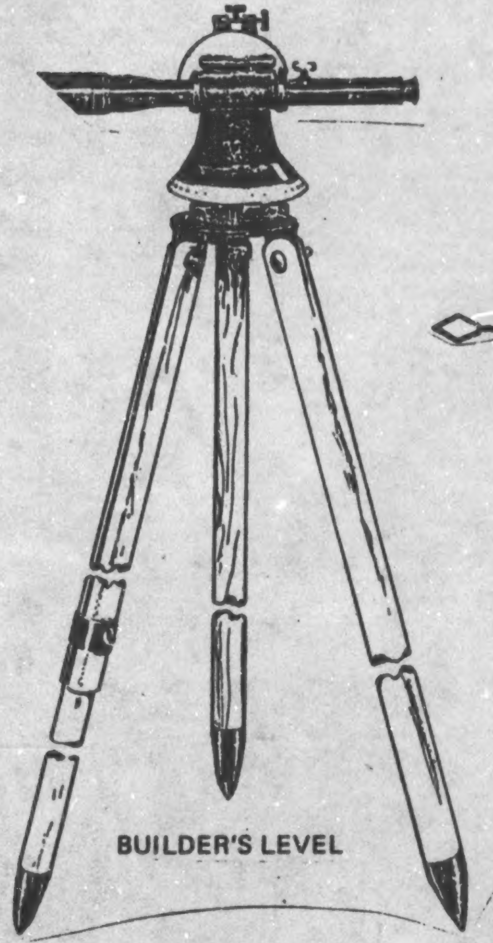


Scaffolding

Site Layout and Measuring Tools

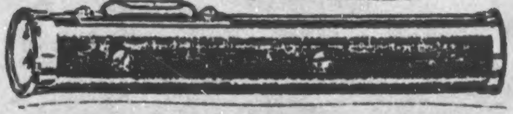


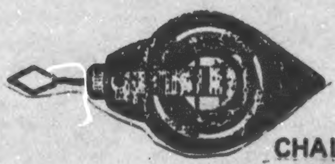
ROD



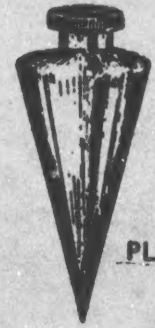
BUILDER'S LEVEL

HAND LEVEL

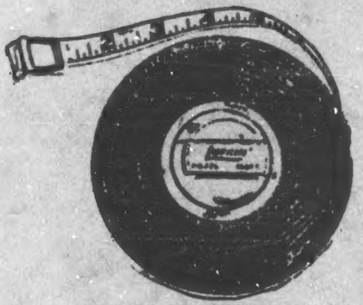




CHALK LINE
AND REEL

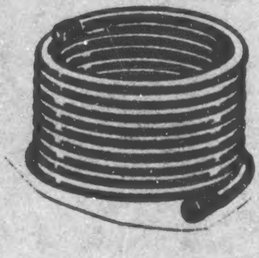


PLUMB BOB

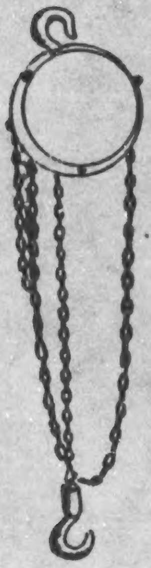


100-FOOT STEEL TAPE

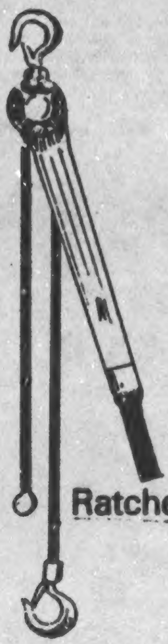
RUBBER HOSE



Hoists, Dolly, and Hand Truck

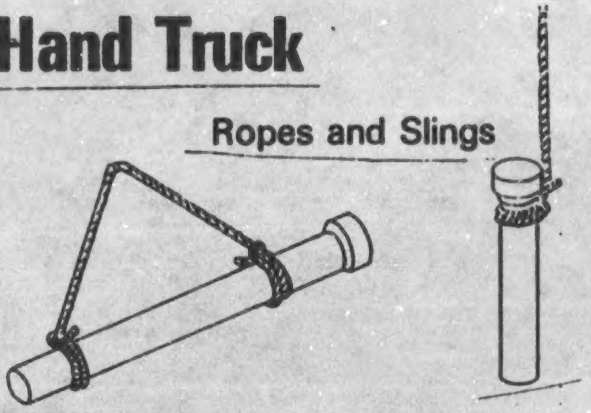


Hand Chain Hoist

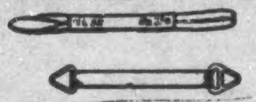


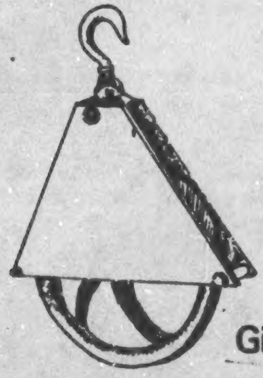
Ratchet Lever Hoist

Ropes and Slings

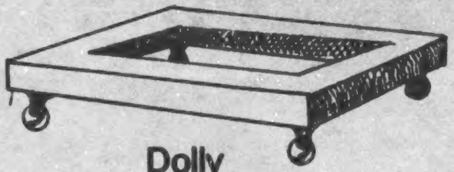


NYLON LIFTING SLINGS

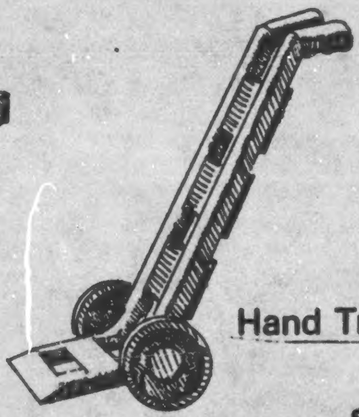




Gin Block



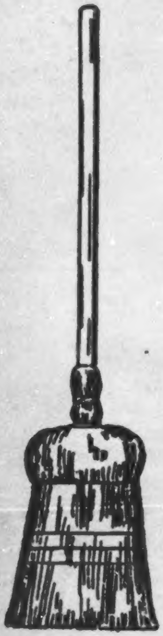
Dolly



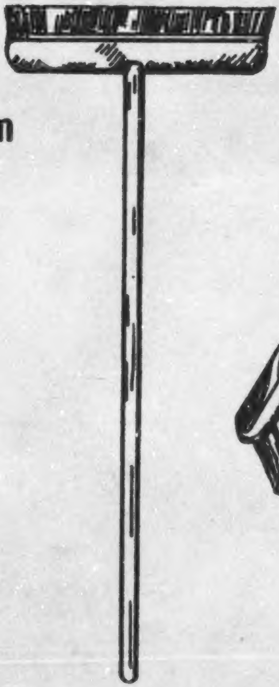
Hand Truck

Cleaning and Excavating Equipment

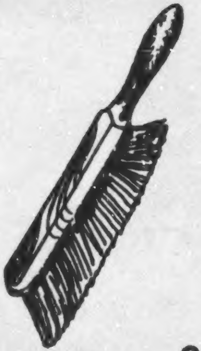
Hand Broom



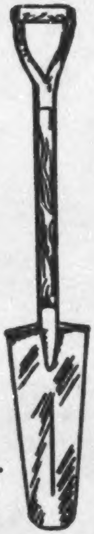
Push Broom



Bench Brush

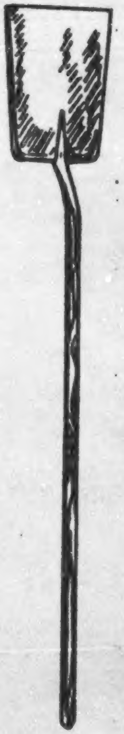


Sharp Shooter

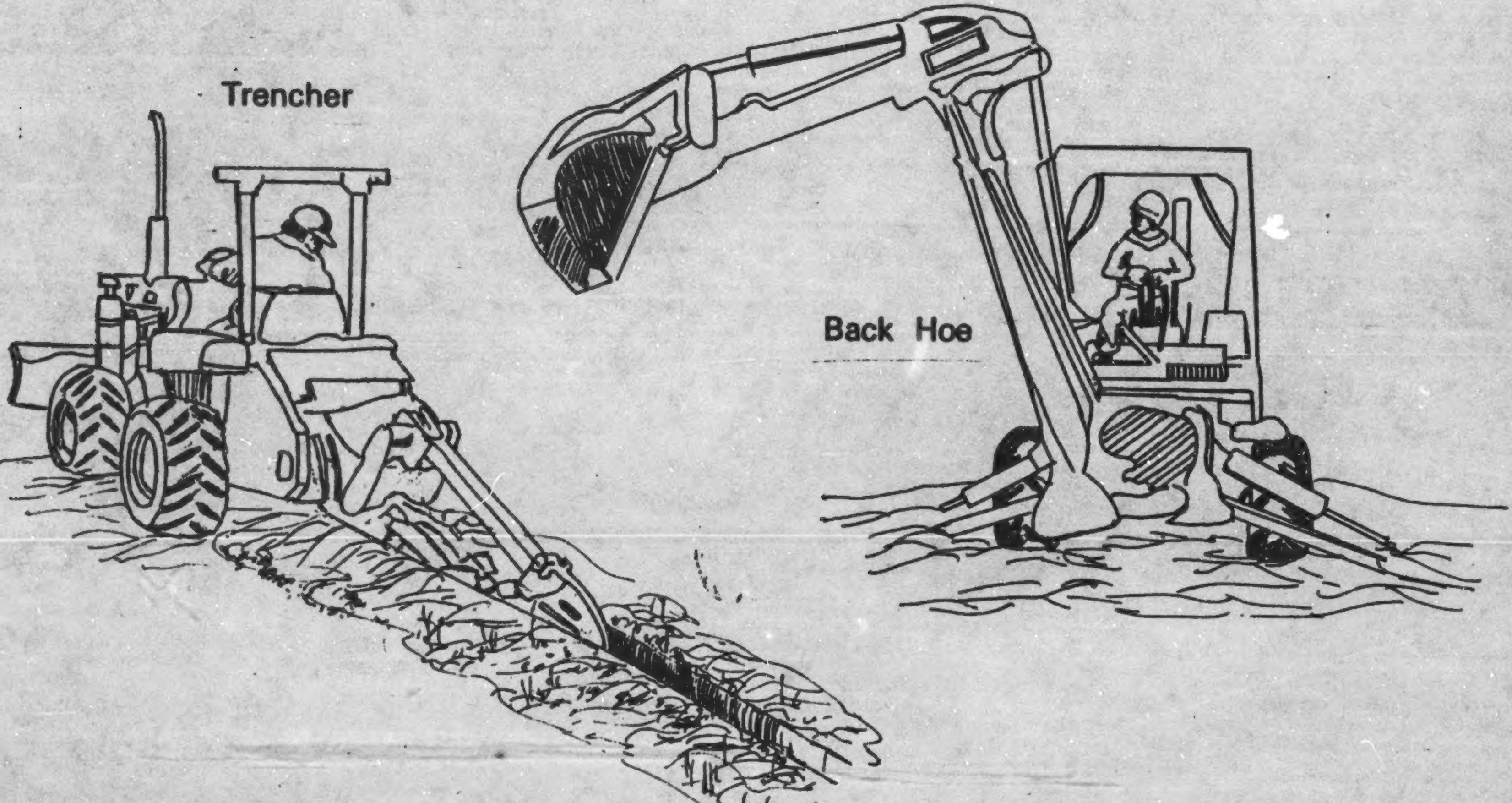


Long Handle
Round Point Shovel

Long Handle
Square Point Shovel

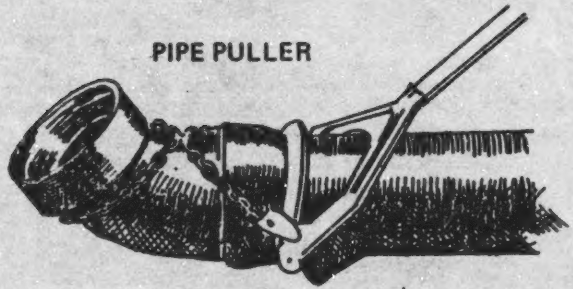


Excavating Equipment

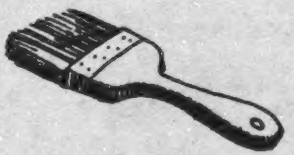

Trencher
Back Hoe

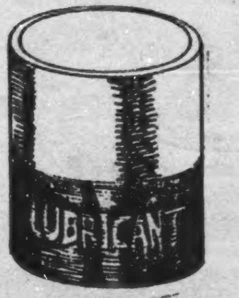
Cast Iron Pipe Assembly Tools

PIPE PULLER



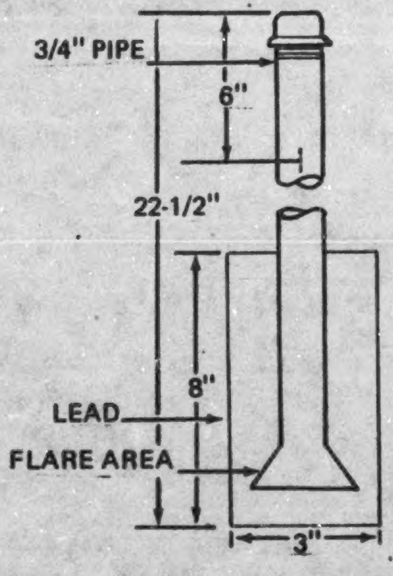
LUBRICANT BRUSH





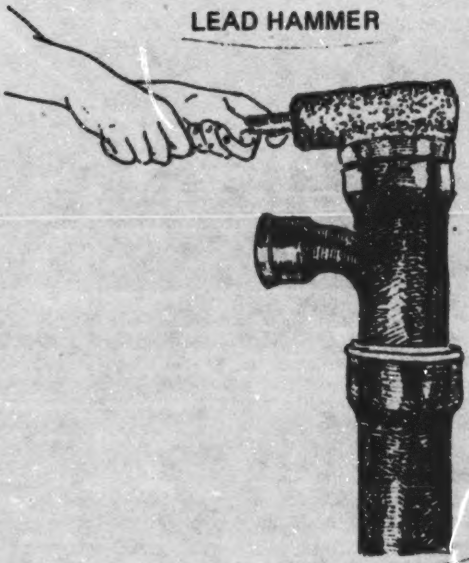
LUBRICANT

A LEAD MAUL THAT THE PLUMBER CAN MAKE TO USE FOR THE ASSEMBLY OF RUBBER GASKET SOIL PIPE JOINTS

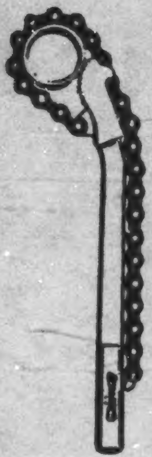

3/4" PIPE
6"
22-1/2"
8"
LEAD
FLARE AREA
3"

SUGGESTED MOLD, 3" CAST IRON PIPE

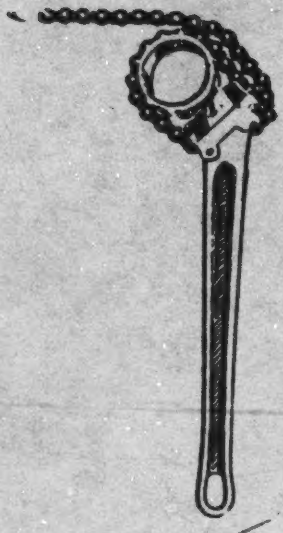
LEAD HAMMER



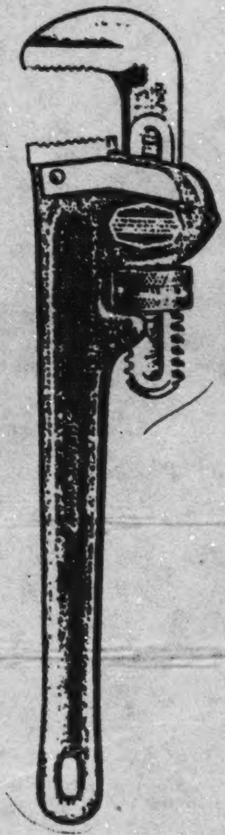
Wrenches



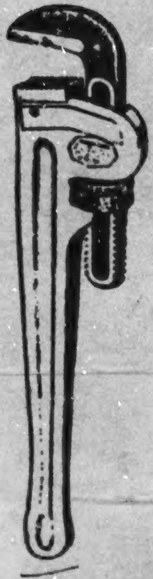
LIGHT DUTY CHAIN WRENCH



HEAVY DUTY CHAIN WRENCH

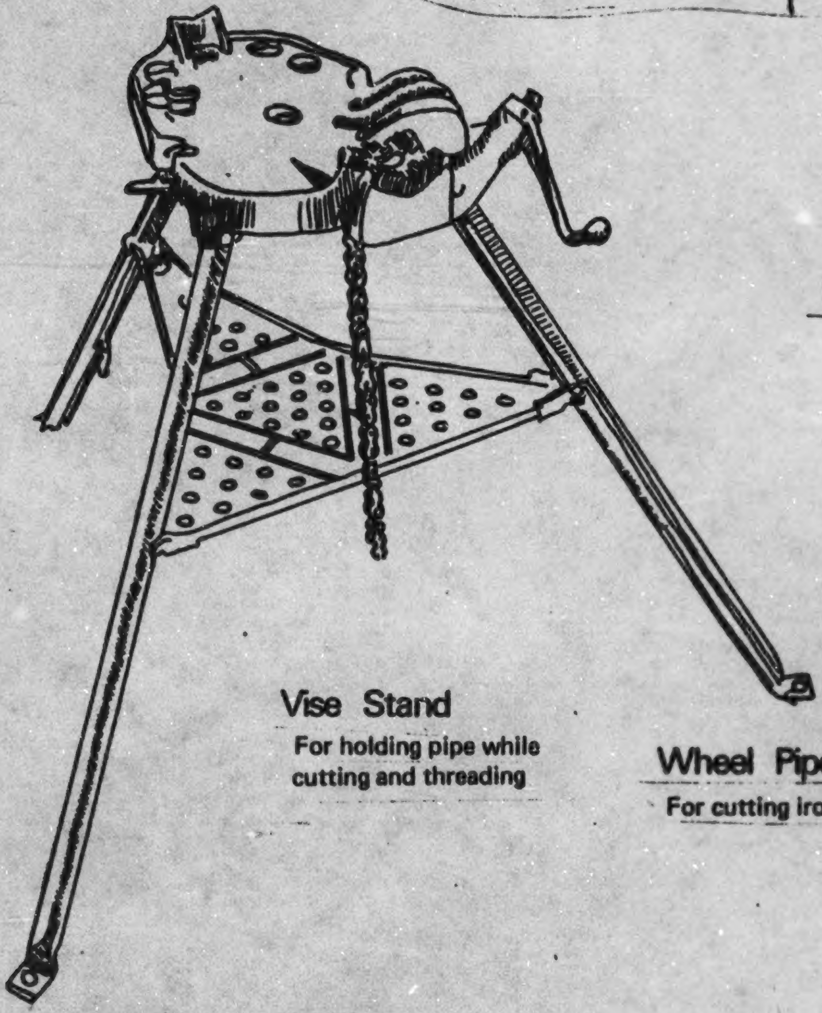


36" STRAIGHT PIPE WRENCH



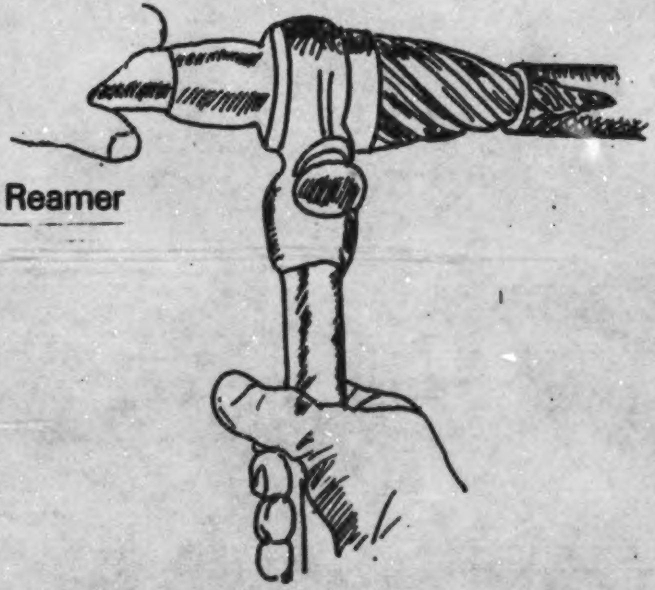
24" STRAIGHT PIPE WRENCH

Pipe Cutting Equipment

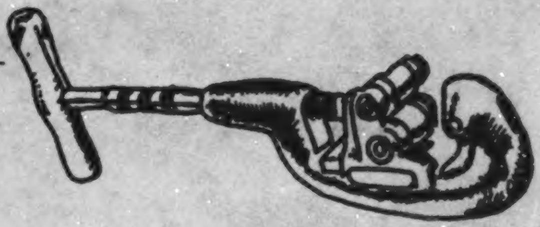


Vise Stand

For holding pipe while cutting and threading



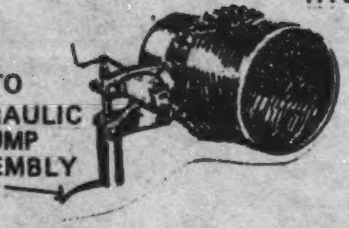
Pipe Reamer



Wheel Pipe Cutter

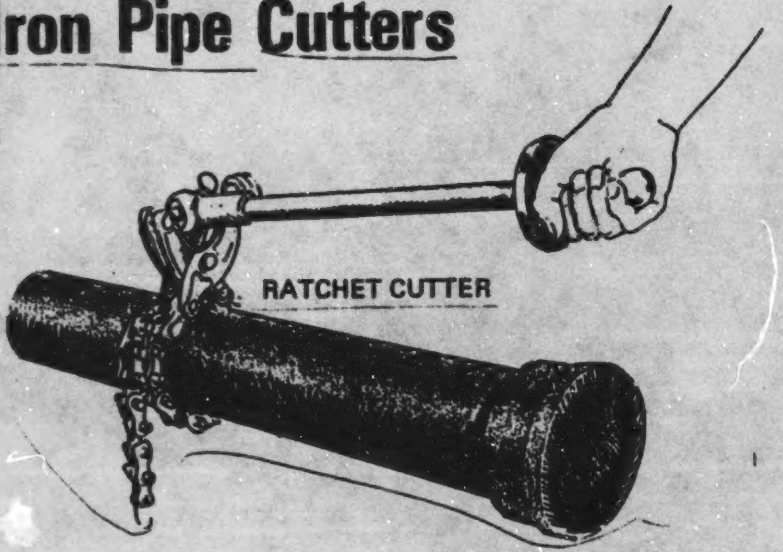
For cutting iron pipe

Cast Iron Pipe Cutters

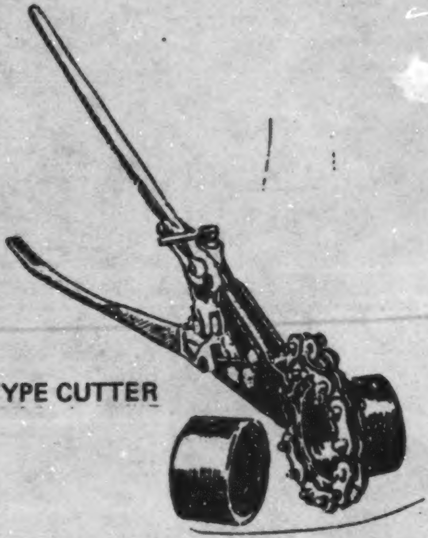


HYDRAULIC CUTTER

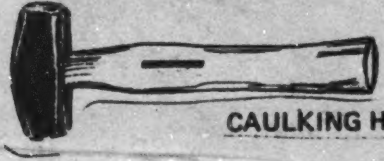
TO HYDRAULIC PUMP ASSEMBLY



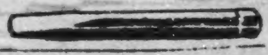
RATCHET CUTTER



SQUEEZE-TYPE CUTTER



CAULKING HAMMER



COLD CHISEL

JOB SHEET #1--LIGHT AND ADJUST THE AIR-ACETYLENE TORCH

EVALUATION: Given access to tools and equipment, light and adjust the air-acetylene torch. Evaluation will include use of correct safety precautions, correct use of tools, and neatness of work performed.

I. Tools and materials

  A. Air-acetylene torch outfit

  B. Acetylene tank valve wrench

  C. Striker

  D. Safety glasses

II. Procedure

  (NOTE: Tank should be purged before regulator is installed.)

  A. Put on safety glasses

  B. Open tank valve 1/2 of a turn

    (NOTE: Leave tank key on tank valve while using this equipment.)

  C. Check system for leaks with soap bubbles

    (CAUTION: Never check for a gas leak with a flame.)

  D. Open torch handle valve 1/4 of a turn

  E. Strike striker immediately

  F. Upon ignition of flame, open torch valve another 1/2 of a turn

    (CAUTION: If flame does not ignite immediately, shut off valve on handle. Delayed ignition could cause an explosion.)

  G. Adjust flame so that inner blue cone is about 1 1/2" long

    (NOTE: If there is an air gap between the inner blue cone and the torch tip, the regulator adjusting screw may need to be turned counterclockwise in order to decrease the pressure.)

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JOB SHEET #1

H. Extinguish by closing tank valve first

I. Let flame burn itself out

J. Close torch handle valve

K. Roll up hose

L. Put away equipment

JOB SHEET #2--SET UP AND ADJUST THE BUILDER'S LEVEL

EVALUATION: Given access to the builder's level and an appropriate location, set up and adjust the builder's level. Evaluation will include correct methods used, care of the instrument, and accuracy of the set up.

I. Tools and equipment

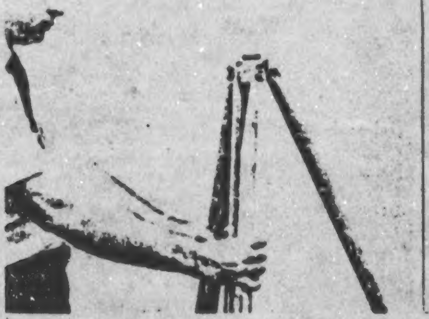
   A. Instrument

   B. Tripod

II. Procedures

   A. Grasp the two legs of the tripod that are nearest you and set the leg shoes in the ground about three feet apart (Figure 1)

FIGURE 1



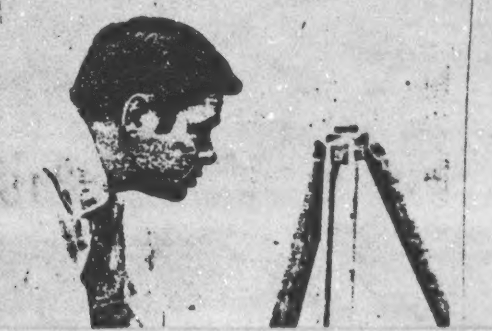
   B. Swing third leg out to form a triangle

   (NOTE: If the ground is not level, you may have to change the position of the tripod in order to keep headplate level.)

   C. Tighten leg thumb nuts

   D. Check headplate to see if it is level (Figure 2)

FIGURE 2



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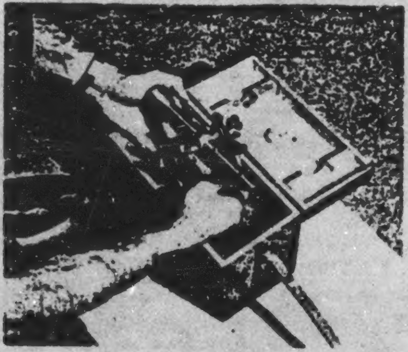
E. Remove instrument from carrying case by lifting the level bar (Figure 3)

(CAUTION: Never grasp the telescope barrel while removing instrument from carrying case.)

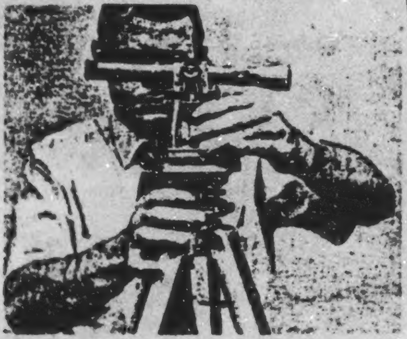
FIGURE 3



F. Attach instrument to head plate by screwing it down (Figure 4)

(CAUTION: Keep a firm grip on instrument until it is securely in position on tripod.)

FIGURE 4



G. Remove dust cap from front lens

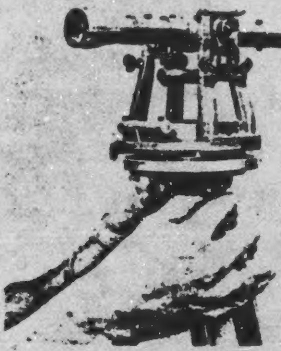
(NOTE: The dust cap should be kept in place in order to protect the lens from dust or scratches.)

H. Attach sun shade to the instrument

I. Align telescope barrel directly over one pair of leveling screws (Figure 5)

(NOTE: The leveling screws will be used just as the name indicates, to level the instrument.)

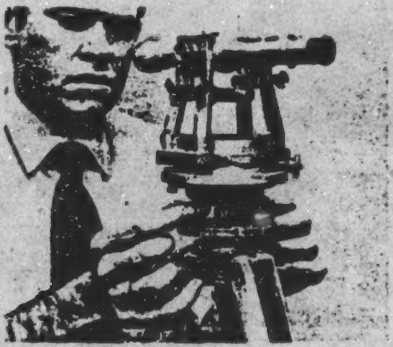
FIGURE 5



J. By rotating screws under the barrel, bring bubble to the center of the leveling tube (Figure 6)

(NOTE: Move your thumbs in opposite directions.)

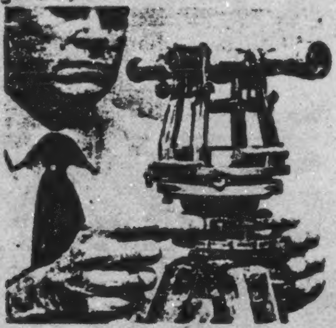
FIGURE 6



K. Check bubble to see if centered

L. Turn instrument clockwise through 90 degrees to align with the other pair of leveling screws (Figure 7)

FIGURE 7



M. Bring bubble to center of marks by rotating leveling screws

N. Turn instrument clockwise through 90 degrees to bring it parallel with first pair of leveling screws

O. Center bubble again

P. Turn instrument clockwise through 90 degrees to bring it parallel with second pair of leveling screws

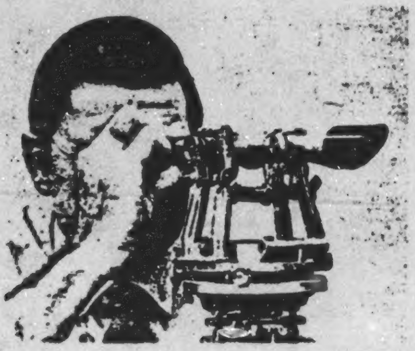
Q. Center bubble again

(NOTE: Bubble should stay in center regardless of what direction the telescope is pointing.)

R. Focus cross hairs so that they appear sharp and clear (Figure 8)

(NOTE: Focusing is accomplished by looking through the eye piece and by turning the eye piece ring until the cross hairs become sharp or "clear.")

FIGURE 8



S. Cross hairs should now be focused, but the target may not be in focus

T. By rotating the focusing screw, bring target into sharp focus (Figure 9)

(NOTE: When cross hairs and target are in sharp focus, you should be able to read a rod accurately.)

FIGURE 9

JOB SHEET #3--SET UP AND LIGHT A PROPANE FURNACE

EVALUATION: Given access to tools, equipment, and materials, set up and light a propane furnace. Evaluation will include use of safety precautions, correct methods of workmanship, and neatness of the work performed.

I. Tools and equipment

  A. Propane tank

  B. Furnace

  C. Tank key

  D. Matches

  E. Short length of oakum

  F. Safety glasses

  G. Matches

II. Procedures

  A. Place the tank on a level section of floor, well away from any inflammable material

  (NOTE: Put on safety glasses)

  B. Install the furnace on the tank

  (NOTE: The furnace-tank connection has right hand threads)

  C. Twist the oakum into a fairly tight string (to avoid burning too quickly) and ignite one end with a match

  D. Open tank valve slowly and ignite gas at furnace

  E. Adjust flame to desired quantity

  F. Ask instructor for approval of job

F-179-B

JOB SHEET #4--SET UP AN INFLATABLE RUBBER TEST PLUG IN A PIPE

EVALUATION: Given access to tools, equipment and materials, set up an inflatable rubber test plug in a pipe. Evaluation will include correct use of tools, accurracy of work, and care in handling equipment.

I. Tools and equipment

   A. Rubber test plug

   B. Tire pump

   C. Pipe

   D. Clean cloth

   E. Safety glasses

II. Procedures

   A. Wipe the inside of the pipe with the cloth to remove any obstructions or objects which could damage the plug

   (NOTE: Wear safety glasses)

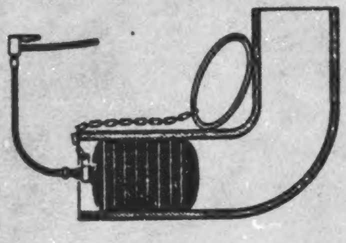
   B. Connect the test plug to the pump hose

   C. Insert the test plug into the pipe

   (NOTE: No part of the plug must extend beyond the end of the pipe)

   D. Inflate the test plug until it is firm and tight in the pipe (Figure 1)

FIGURE I



P-181-E

E. Ask instructor for approval of job

F. Clean up the area and replace tools and equipment

182-B

JOB SHEET #5--SET UP A MECHANICAL TEST PLUG IN A PIPE

EVALUATION: Given access to tools, equipment, and materials, set up a mechanical test plug in a pipe. Evaluation will include correct use of tools, accuracy of work, and care in handling equipment.

I. Tools and equipment

- A. Test plug
- B. Pipe
- C. Oil can
- D. 12" pipe wrench
- E. Clean cloth
- F. Safety glasses

II. Procedures

- A. Put on safety glasses
- B. Turn the wing nut counterclockwise, loosening the test plug
- C. Lightly oil the threaded portion of the plug

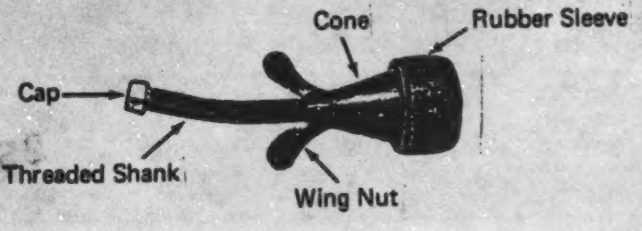
  (NOTE: Avoid getting oil on the rubber sleeve of the plug as oil can damage rubber.)

- D. If the pipe end of the plug is not to be used to fill the system with water, tighten the cap with the 12" wrench

  (NOTE: Use pipe dope on the male threads to help ensure a sealed joint.)

- E. Turn the wing nut clockwise until it is snug against the cone of the plug (Figure 1)

FIGURE I



P-185-F

F. Wipe the rubber ring and the inside of the pipe with a clean cloth to remove any sand or grit

G. Insert the plug into the end of the pipe

(NOTE: Allow enough room for the wing nut to be tightened without it touching the pipe end.)

H. Screw the wing nut clockwise, expanding the rubber ring against the inside circumference of the pipe

(NOTE: Keep test plug straight in pipe to assure a good sealing effect.)

I. Obtain the approval of the instructor

J. Loosen the test plug and remove from pipe

K. Clean up area and put all tools and materials away

EQUIPMENT
UNIT III

JOB SHEET #6–SET UP AND OPERATE A RATCHET LEVER HOIST

EVALUATION: Given access to tools and equipment, set up and operate a ratchet lever hoist. Evaluation will include correct use of equipment and use of safety precautions.

I. Tools and equipment

  A. Ratchet lever hoist

  B. Heavy object such as a large pipe or bathtub

  C. Rope, chain, and/or sling

  D. Safety glasses

II. Procedure

  A. Put on safety glasses

  B. Secure upper hook of hoist to overhead beam (Figure 1)

  (NOTE: A short length of chain is best for this operation.)

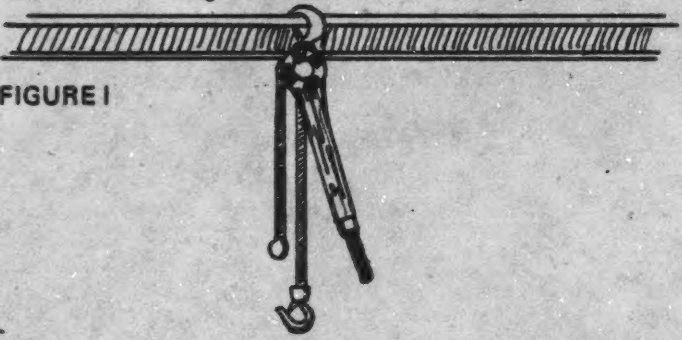
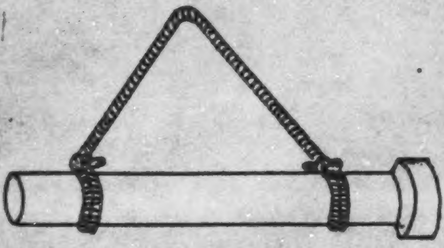


FIGURE I

  C. Run out enough cable to allow object to be lifted the desired height

  D. Secure object to be lifted with slings or rope (Figure 2)

FIGURE 2

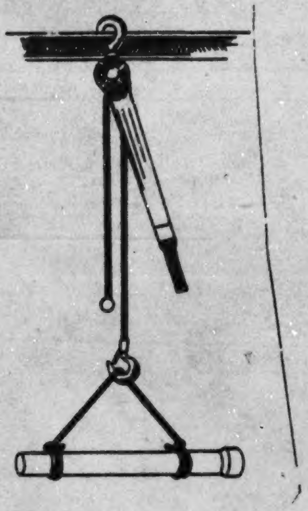


p-185-B

E. Attach lower hoist hook to sling and tighten cable with ratchet

F. Lift object an inch off the floor and check all parts of the lifting assembly (Figure 3)

FIGURE 3



G. Operate ratchet until object is lifted to the desired height

H. Obtain approval of your instructor

I. Turn ratchet to "reverse" and lower object to floor

J. Remove lower cable hook and sling

K. Remove hoist and chain support

L. Return tools and materials to proper storage place

JOB SHEET #7–GRIND A FLAT TIP SCREWDRIVER

EVALUATION: Given access to tools and equipment, grind a flat tip screwdriver. Evaluation will include use of safety precautions, correct use of tools and equipment, and accuracy of work performed.

I. Tools and equipment

   A. Flat tip screwdriver

   B. Bench grinder

   C. Water tray

   D. Safety glasses

II. Procedure

   A. Put on safety glasses

   B. Adjust clearance of tool rest

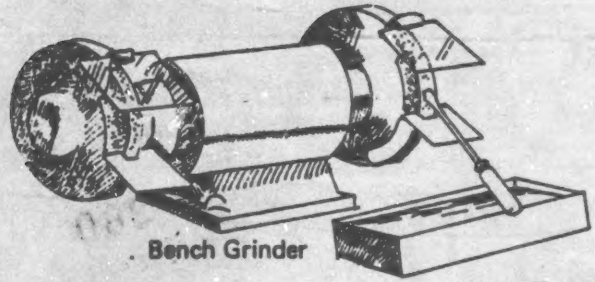
   (NOTE: Proper clearance is approximately 1/8" from grinding wheel.)

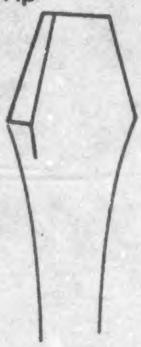
   C. Turn on grinder

   (NOTE: Dress grinding wheel if necessary.)

   D. Grind tip of blade flat (Figure 1)

FIGURE 1

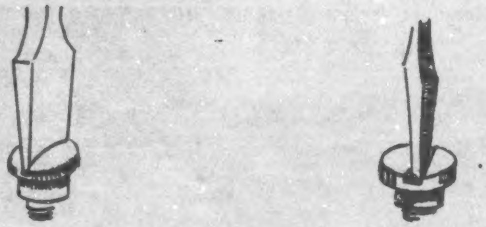




p-197-6

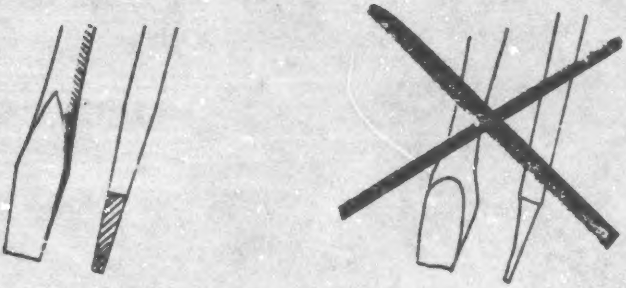
E. Grind sides of blade to manufacturer's original specifications (Figure 2)

FIGURE 2



Ground Right

Ground Wrong



(NOTE: Cool tip in tray of water often while grinding to prevent softening of the tip.)

EQUIPMENT
UNIT III

JOB SHEET #8–GRIND THE HEAD OF A COLD CHISEL OR PUNCH

EVALUATION: Given access to tools and equipment, grind the head of a chisel or punch. Evaluation will include use of safety precautions, correct use of tools and equipment, and accuracy of work performed.

I. Tools and materials

- A. Chisel and/or punch
- B. Bench grinder
- C. Water tray
- D. Safety glasses

II. Procedure

- A. Put on safety glasses
- B. Adjust clearance of tool rest

  (NOTE: Proper clearance is approximately 1/8" from grinding wheel.)

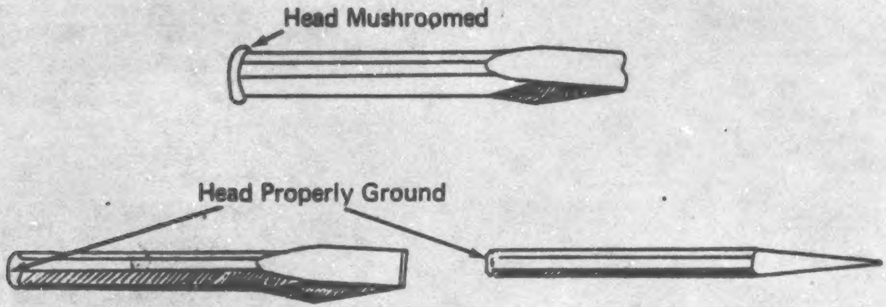
- C. Turn on grinder

  (NOTE: Dress grinding wheel if necessary.)

- D. Grind a bevel on the head (Figure 1)

  (CAUTION: When the head of a punch or chisel is mushroomed, chips could break off during use causing injury to the user.)

FIGURE 1



EQUIPMENT
UNIT III

JOB SHEET #9–SHARPEN A COLD CHISEL

EVALUATION: Given access to tools and equipment sharpen a chisel. Evaluation will include use of safety precautions, correct use of tools and equipment, and accuracy of work performed.

I. Tools and materials

   A. Chisel

   B. Bench grinder

   C. Water tray

   D. Safety glasses

II. Procedure

   A. Put on safety glasses

   B. Adjust clearance of tool rest

   (NOTE: Proper clearance is approximately 1/8" from grinding wheel.)

   C. Turn on grinder

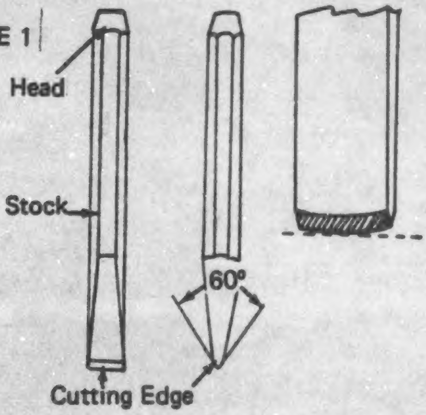
   D. Hold the chisel's cutting edge against the grinding wheel with very little pressure

   (NOTE: This will help to prevent overheating of the chisel's cutting edge. Dip the chisel in the water frequently to cool.)

   E. Grind the edge on a slight curve (Figure 1)

   (CAUTION: Hold the chisel with a firm grip during the grinding process.)

FIGURE 1



EQUIPMENT
UNIT III

NAME________________________

TEST

1. Match the terms on the right to the correct descriptions and definitions.

_____a. A heavy, flammable, gaseous, paraffin hydrocarbon found in crude petroleum and natural gas and used as a fuel

_____b. Tool used to create a controlled flame which is used for soldering copper fittings

_____c. A colorless, gaseous hydrocarbon made by the action of water on calcium carbide and used as a fuel

_____d. Isolating a piping system with plugs of various types and applying air pressure, water, smoke or other agents in order to check for leaks in the system

_____e. Instrument used to lift heavy objects with the least amount of strain on the worker

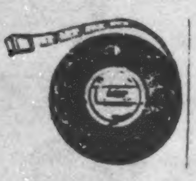
_____f. Instruments used to determine grade when installing long lengths of pipe

_____g. Excavation made for the installation of pipe

_____h. Electric powered grinding wheel used to sharpen tools and wear away excess metal from various objects

1. Bench grinder
2. Test
3. Hoist
4. Trench
5. Torch
6. Propane
7. Acetylene
8. Optical instruments

2. Identify equipment generally used in residential plumbing.



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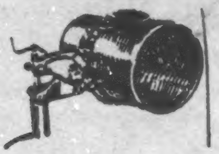
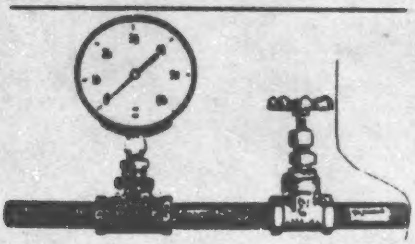
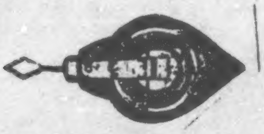


b. ____________________



c. ____________________



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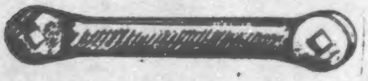

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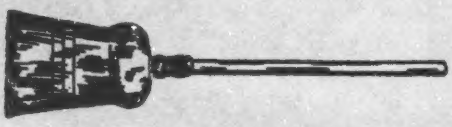

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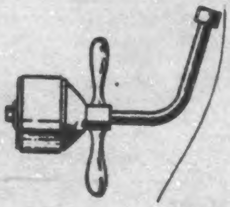

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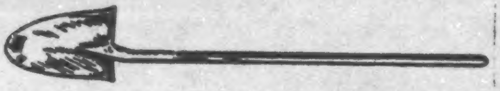

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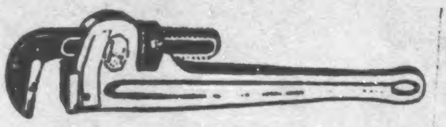

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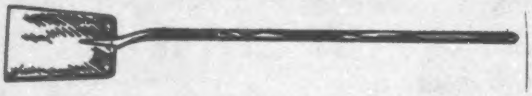

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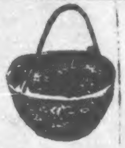

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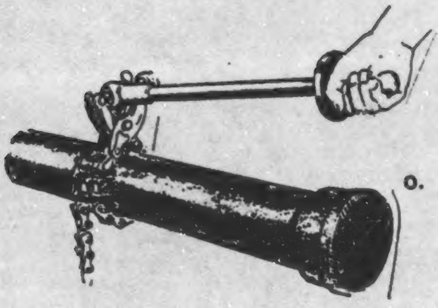
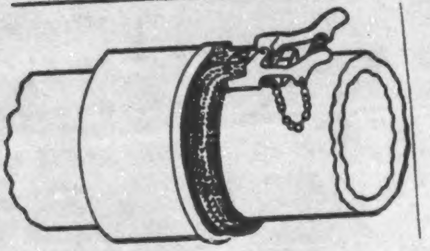
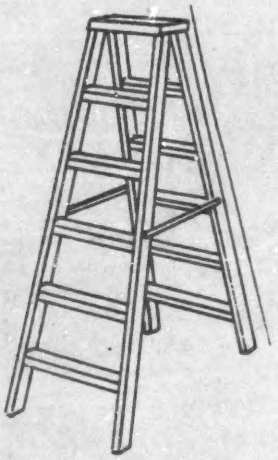


l. ______________________________



m. ______________________________



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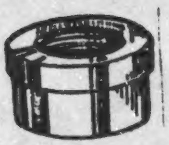

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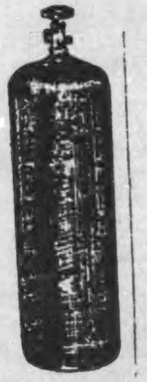

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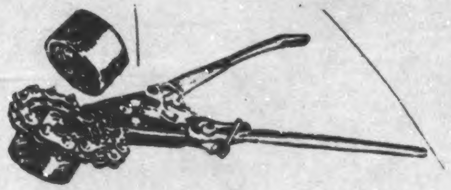
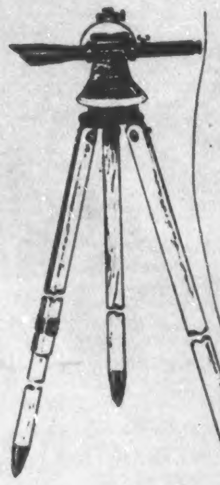
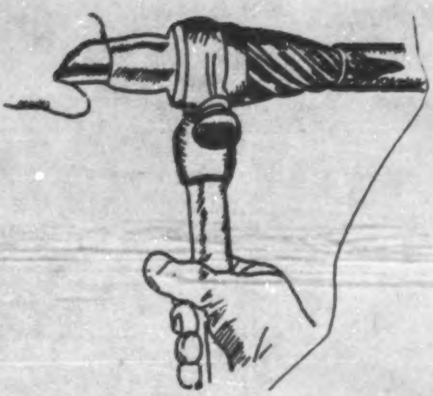


q. ______________________________



r. ______________________________



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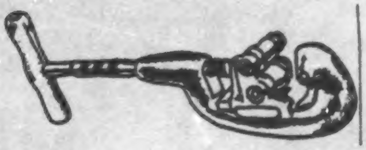

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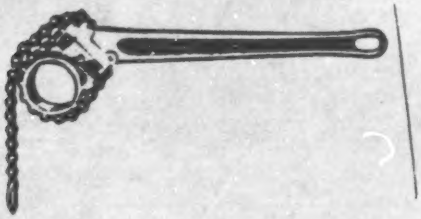
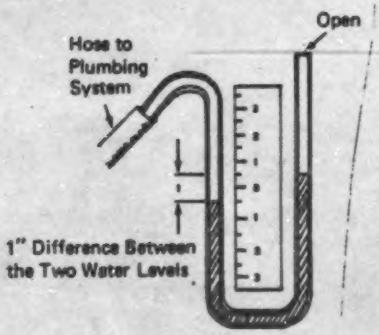
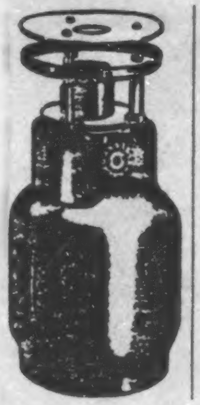


u. ____________________


Hose to Plumbing System
Open
1" Difference Between the Two Water Levels

v. ____________________



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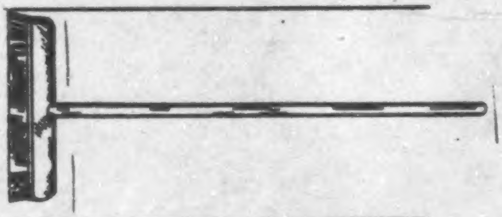

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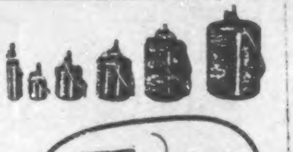

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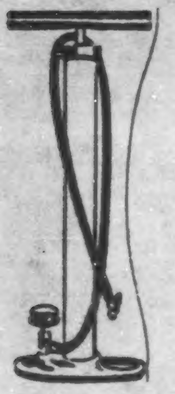

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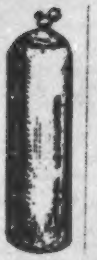

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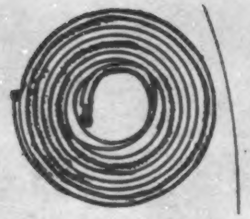

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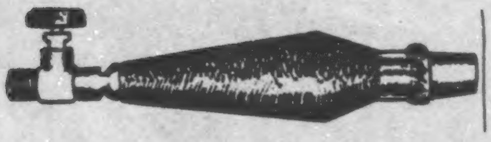

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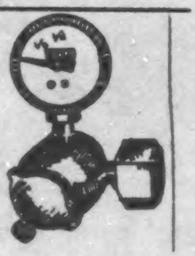

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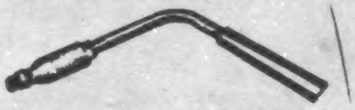

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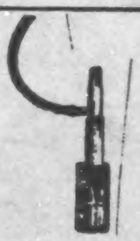

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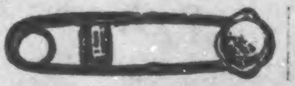

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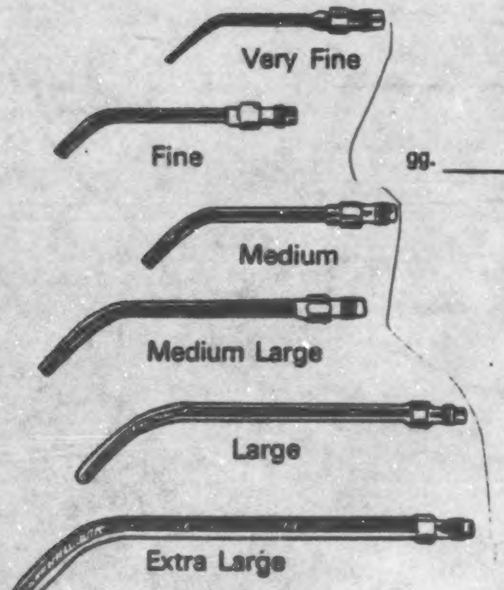
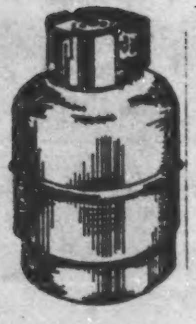
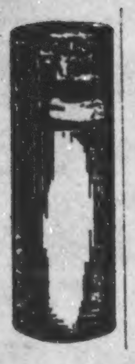
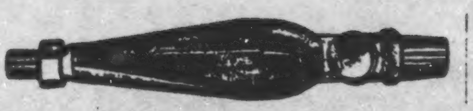

Very Fine
Fine
Medium
Medium Large
Large
Extra Large

ff. ______________

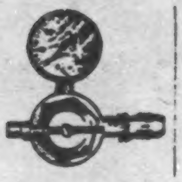
P-197-8

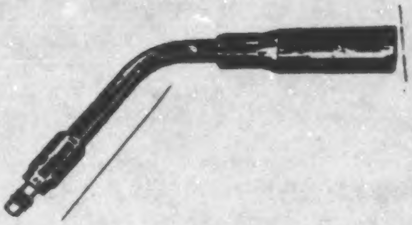


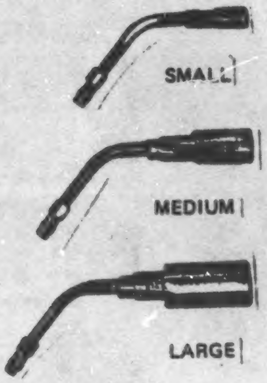




ii. ______________ jj. ______________ kk. ______________






SMALL
MEDIUM
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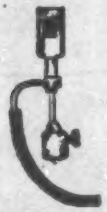
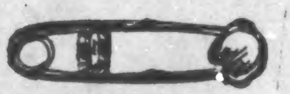
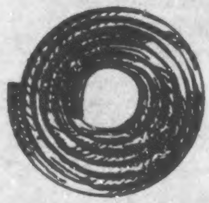
ll. ______________ mm. ______________

nn. ______________

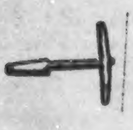


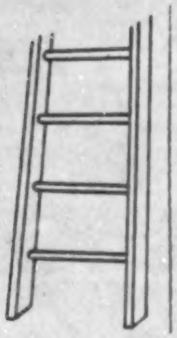


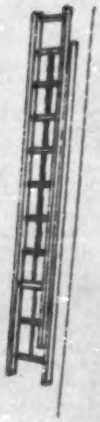
oo. ______________ pp. ______________



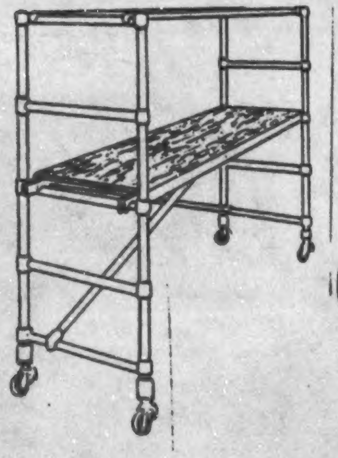
qq. ______________

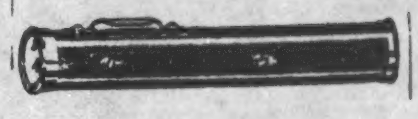


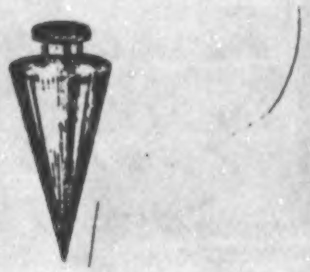




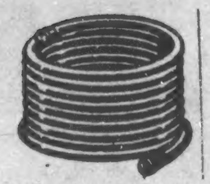
rr. ______________ ss. ______________ tt. ______________

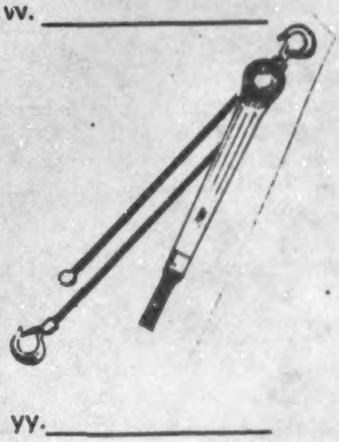


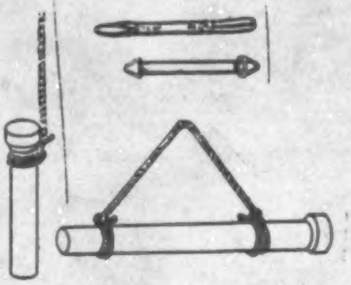




uu. ______________ vv. ______________ ww. ______________

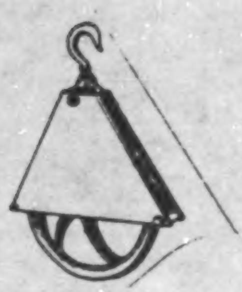


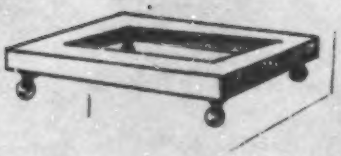




xx. ______________ yy. ______________ zz. ______________

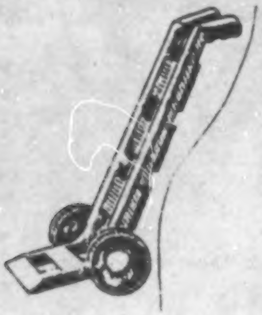
P-199-E

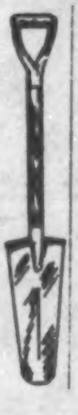


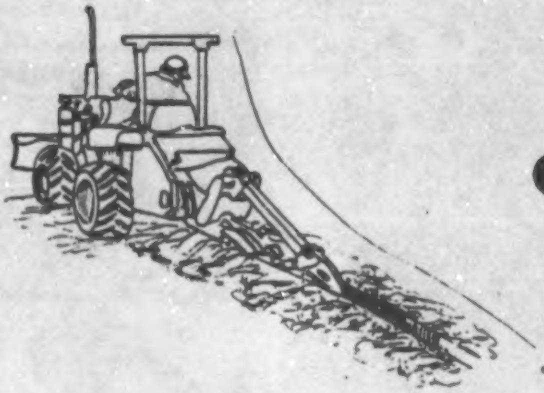


aaa. ____________________

bbb. ____________________



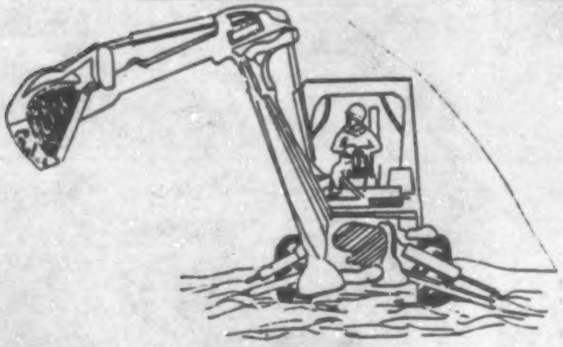


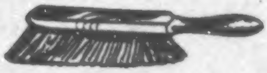


ccc. ____________

ddd. ____________

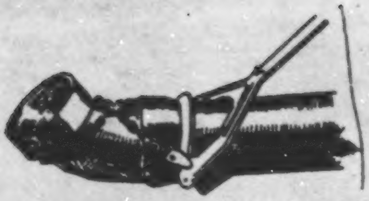
eee. ____________

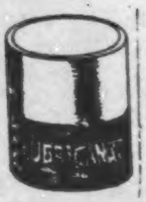


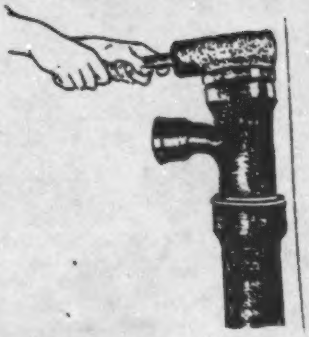


fff. ____________________

ggg. ____________________



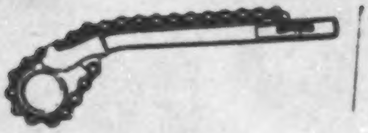


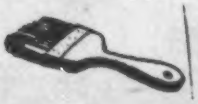


hhh. ______________

iii. ______________

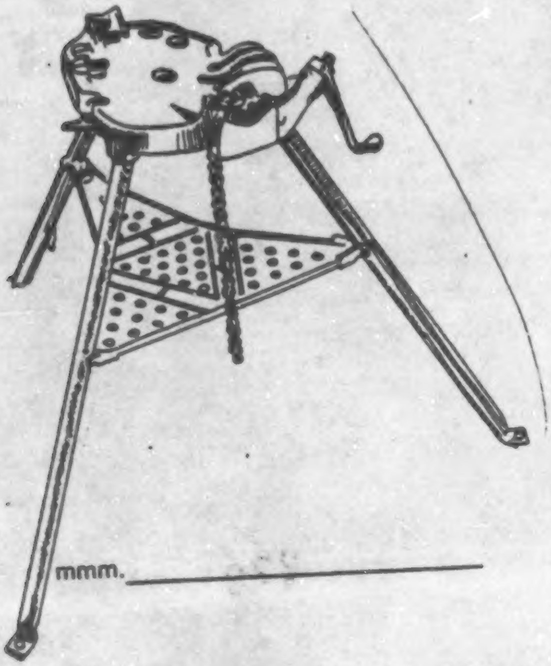
jjj. ______________

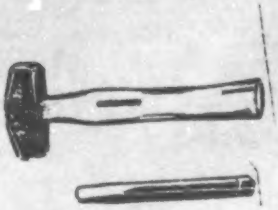




kkk. ______________

lll. ______________

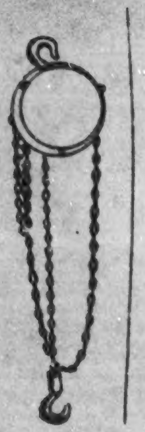




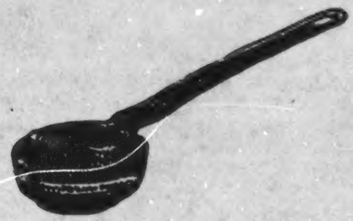
mmm. ______________

nnn. ______________

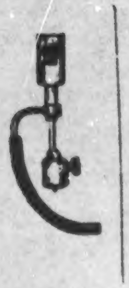
P-361-F



ooo. ____________________



ppp. ____________________



qqq. ____________________

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3. Match the types of equipment on the right to their correct use or care statement.

_____a. Used to seal a drainage system or part of a drainage system in order to check for leaks

_____b. Used to heat copper tube and melt solder to make sweat joints

_____c. Used to melt lead for caulking cast iron soil pipe

_____d. Used for working short distances above ordinary reach level

_____e. Used to reach the roof of single story buildings

_____f. Used to reach the roof of two-story buildings

_____g. Used to raise or lower pipes or to hold them temporarily in position

_____h. Used to lift or pull heavy loads for short distances

_____i. Can transport heavy objects along level surfaces and slight grades

_____j. Can transport heavy objects over rough ground, up and down stairs, up and down steep grades, and over level surfaces

_____k. Are used for general digging purposes

_____l. Are used to make tunnels under sidewalks, shrubs, driveways, porches, or footings

_____m. Are used for cutting straight lines in grass sod, squaring corners of excavations, and helping to make tunnels under sidewalks, shrubs, driveways, or porches

_____n. Are used to dig narrow and comparatively shallow trenches

_____o. Dig wide (average 18"-24") and deep (average 8'-10')

_____p. Used to install fittings

1. Lead hammer
2. Torch
3. Dolly
4. Ratchet lever hoist
5. Test caps
6. Manometer
7. Power trencher
8. Extension ladder
9. Stepladder
10. Hand levels
11. Backhoe
12. Sharp shooter shovel
13. Ropes and slings
14. Assembly tools
15. Square point shovel
16. Scaffolds

P-203-B

_____q. Are used to pull cast iron pipes and fittings together

_____r. Is used by the residential plumber primarily to determine pitch of long runs of pipe

_____s. Help make lifting easier and help prevent strains and bruises

_____t. Permit light and medium weight objects to be lifted considerable distances with savings of time and energy

_____u. Used to inflate rubber test plugs after they are inserted in the piping system

_____v. Used to attach the air pump to the piping system being tested and to show amount of pressure on a gauge

_____w. Usually provided by bricklayers, plasterers, and/or painters, and are sometimes used by plumbers to reach high places in the building

_____x. Useful for making rough measurements of trench depths

_____y. Device used to measure the amount of pressure developed in a piping system being tested

_____z. Used to seal the ends of pipes in order to seal the system for a test

17. Round point shovel
18. Test gauge assembly
19. Tire pump
20. Builder's level
21. Furnace
22. Hand truck
23. Single ladder
24. Hand chain hoist
25. Gin block
26. Mechanical test plug

4. List two safety precautions for each part of the air-acetylene torch outfit.

   a. Regulator

      1)

      2)

   b. Gauges

      1)

      2)

c. Hoses

  1)

  2)

d. Torches

  1)

  2)

e. Torch tips

  1)

  2)

5. Demonstrate the ability to:

   a. Light and adjust the air-acetylene torch.

   b. Set up and adjust the builder's level.

   c. Set up and light a propane furnace.

   d. Set up an inflatable rubber test plug in a pipe.

   e. Set up a mechanical test plug in a pipe.

   f. Set up and operate a ratchet lever hoist.

   g. Grind a flat tip screwdriver.

   h. Grind the head of a cold chisel or punch.

   i. Sharpen a cold chisel.

   (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

ANSWERS TO TEST

1. a. 6
   b. 5
   c. 7
   d. 2
   e. 3
   f. 8
   g. 4
   h. 1
2. a. 100' steel tape
   b. Hydraulic cast iron pipe cutter
   c. Test gauge assembly
   d. Chalk line and reel
   e. Cylinder wrench (air-aceylene torch outfit)
   f. Hand broom
   g. Mechanical test plug
   h. Round point shovel
   i. Straight pipe wrench
   j. Square point shovel
   k. Lead pot
   l. Ratchet cast iron pipe cutter
   m. Joint runner
   n. Stepladder

o. Test cap

p. "B" acetylene tank

q. Squeeze type cast iron pipe cutter

r. Builder's level

s. Pipe reamer

t. Wheel pipe cutter

u. Heavy duty chain wrench

v. Manometer

w. Propane furnace

x. Push broom

y. Inflatable rubber test plug

z. Tire pump

aa. "MC" acetylene tank

bb. Hose (air-acetylene torch outfit)

cc. Torch handle (air-acetylene torch outfit)

dd. Regulator (air-acetylene torch outfit)

ee. High temperature wraparound flame tip (air-acetylene torch outfit)

ff. Tips (air-acetylene torch outfit)

gg. Halide torch leak detector (air-acetylene torch outfit)

hh. Striker (air-acetylene torch outfit)

ii. Liquified petroleum cylinder, 20 lbs. capacity

jj. Liquified petroleum cylinder, 2-1/2 lbs. capacity

kk. Torch handle (air-propane outfit)

ll. Regulator (air-propane outfit)

mm. High temperature wraparound flame tip (air-propane outfit)

nn. Standard tips (air-propane outfit)

oo. Halide torch leak detector (air-propane outfit) pp. Striker (air propane outfit)

qq. Hose (air-propane outfit)

rr. Tank key

ss. Single ladder

tt. Extension ladder

uu. Scaffolding

vv. Hand level

ww. Plumb bob

xx. Rubber hose

yy. Ratchet lever hoist

zz. Ropes and slings

aaa. Gin block

bbb. Dolly

ccc. Hand truck

ddd. Sharp shooter shovel

eee. Power trencher

fff. Backhoe

ggg. Bench brush

hhh. Pipe puller

iii. Lubricant

jjj. Lead hammer

kkk. Ligh duty chain wrench

lll. Lubricant brush

mmm. Vise stand

nnn. Caulking hammer and chisel

ooo. Hand chain hoist

ppp. Lead ladle

qqq. Halide torch leak detector (air-acetylene torch outfit)

3. a. 26

b. 2

c. 21

d. 9

e. 23

f. 8

g. 24

h. 4

i. 3

j. 22

k. 17

l. 12

m. 15

n. 7

o. 11

p. 1

q. 14

r. 20

s. 13

t. 25

u. 19

v. 18

w. 16

x. 10

y. 6

z. 5

4. Any two safety precautions from each of the following sections:
   - a. Regulator
     - 1) Keep regulator off when not in use
     - 2) Be sure to turn adjustment screw completely off prior to start up
     - 3) Inspect all nuts and connections prior to using the regulators
     - 4) Do not force connections of hoses and regulators
     - 5) Use the proper regulator on the proper cylinder
     - 6) Do not exceed recommended pressures
     - 7) Have only skilled mechanics repair faulty regulators
   - b. Gauges
     - 1) Keep glass protected from breaking
     - 2) Replace any broken gauge glasses
     - 3) Do not attempt to repair a defective gauge
   - c. Hoses
     - 1) Test hoses for leaks by immersing in water at normal working pressure
     - 2) Use only one type of gas in the hose
     - 3) Avoid dragging the hose on a greasy floor
     - 4) Avoid circumstances where a hose can be rolled upon, kinked, burned, or subjected to falling objects or hot metals
     - 5) Keep hose connections tight
     - 6) Do not repair a hose with tape
     - 7) Keep the hose properly rolled and stored when not in use
   - d. Torches
     - 1) Keep all connections to the torch tight
     - 2) Any torch suspected of being faulty should be repaired by a competent serviceman
     - 3) Avoid any contact with greasy or oily substances
     - 4) Restrictions in the tip may cause back pressure and leakage

e. Torch tips

   1) Do not remove a tip from the torch when it is hot

   2) Use the manufacturer's wrench to remove the torch tip

5. Performance skills evaluated to the satisfaction of the instructor.

PLUMBER'S TOOL BOX
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify those tools which should be included in a plumber's tool box. The student should also be able to select true statements about the use and care of each tool and list safety precautions to be taken when using these tools. This knowledge will be evidenced by scoring 85 percent on the unit test.

(NOTE: The student must score 100 percent on the safety section of the test.)

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with the plumber's tool box to the correct definitions.
2. Identify tools usually found in a plumber's tool box.
3. Select true statements about the use and care of tools usually found in a plumber's tool box.
4. List safety precautions applied to the use of tools usually found in a plumber's tool box.

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PLUMBER'S TOOL BOX
UNIT IV

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information sheet.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Show and explain uses for various tool boxes available to the plumber.

   G. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1–Types of Handsaws

      2. TM 2--Files and Measuring Tools

      3. TM 3--Levels, Plumb Bob, and Chalk Line

      4. TM 4--Chisels and Punches

      5. TM 5--Drilling and Boring Tools

      6. TM 6--Wrenches

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7. TM 7--Wrenches (Continued)

8. TM 8--Screwdrivers and Pliers

9. TM 9--Hammers

10. TM 10--Tubing Cutters

11. TM 11--Copper Tubing Tools

12. TM 12--Straight Snips, Pipe Taps, and Putty Knife

13. TM 13--Faucet and Toilet Tank Repair Tools

14. TM 14--Caulking Tools and Eye Protection

D. Test

E. Answers to test

II. References:

A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1978.

B. Bureau of Naval Personnel. *Tools and Their Uses.* Washington, D.C.: U.S. Government Printing Office, 1971.

PLUMBER'S TOOL BOX
UNIT IV

INFORMATION SHEET

I. Terms and definitions

  A. Repair tools–Those tools, including special tools, which are used primarily for reconditioning of piping systems valves, faucets, fixtures, and other components

  B. Installation tools–General construction tools which consists of small tools provided by the worker and more expensive tools provided by the employer

  C. Specialty tools–Expensive tools or tools used for a specific purpose, usually provided by the employer

  D. Hand tools–Hand held tools used for common plumbing jobs, usually owned by the plumber

II. Tools for the plumber's tool box

  A. Saws (Transparency 1)

    1. Hacksaw
    2. Jabsaw
    3. Compass or keyhole saw
    4. Handsaw
    5. Miter saw

  B. Files (Transparency 2)

    1. Flat
    2. Round
    3. Triangular
    4. Rasp

  C. Measuring tools (Transparency 2)

    1. Folding rule
    2. Tape measure

  D. Levels (Transparency 3)

    1. 24" carpenter's
    2. Torpedo

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   3. Line
   4. Plumber's

E. Plumb bob and line (Transparency 3)

F. Chalk line (Transparency 3)

G. Chisels and punches (Transparency 4)
   1. Set of cold chisels
   2. Set of wood chisels
   3. Nail set
   4. Set of pin punches
   5. Center punch

H. Drilling and boring tools (Transparency 5)
   1. Drilling tools
      a. Hand drilling machine
      b. Set of high speed drills
      c. Set of small masonry drills
      d. Star drill
   2. Boring tools
      a. Ratchet brace
      b. Set of wood bits (1/2", 3/4", 1")
      c. Expansive wood bit (3/4" - 2")

I. Wrenches (Transparencies 6 and 7)
   1. Set of straight pipe wrenches (8", 12", 14", 18")
   2. 14" offset pipe wrench
   3. 8" adjustable wrench
   4. Set of open end wrenches
   5. 8" plier wrench (vise grips)
   6. Set of flare nut wrenches

7. Set of socket wrenches and ratchet
8. 12" spud wrench
9. No-hub torque wrench
10. Plug wrench
11. Sink strainer wrench
12. Strainer locknut wrench
13. Closet seat wrench
14. Basin wrench
15. Strap wrench
16. All-purpose wrench
17. Internal wrench

J. Pliers (Transparency 8)

1. Needlenose pliers
2. 14" adjustable pliers
3. 10" adjustable pliers
4. Combination slip-joint pliers
5. Dykes (lineman's pliers)

K. Screwdrivers (Transparency 8)

1. Set of phillips head screwdrivers
2. Set of straight tip screwdrivers
3. Offset screwdriver

L. Hammers and nail pullers (Transparency 9)

1. 20 oz. straight claw hammer
2. 16 oz. ball peen hammer
3. Sledge hammer
4. Nail puller (cats-paw)

INFORMATION SHEET

M. Tubing cutters (Transparency 10)
   1. Small diameter tubing cutter (1/8" - 1")
   2. Small quick opening tubing cutter (1/4" - 1 1/8")
   3. Large tubing cutter (1/4" - 3 1/8")
   4. Close tubing cutter (1/2", 3/4")
   5. Internal cutters

N. Copper tubing tools (Transparency 11)
   1. Striker
   2. Flux brush
   3. Clean towel
   4. Sandcloth
   5. Pocket knife
   6. Yoke and screw flaring tool
   7. Hammer flaring tool
   8. Swaging tool
   9. Set of copper fitting brushes
   10. Tubing bender - 1/2", 3/4"
       a. Lever type bender
       b. Geared ratchet type bender
   11. Spring bender--3/8", 7/16", 1/2", 5/8"

O. Pair of straight snips (Transparency 12)

P. Pipe taps (1/8" - 1") (Transparency 12)

Q. Putty knife (Transparency 12)

R. Faucet and toilet tank repair tools (Transparency 13)
   1. Faucet handle puller
   2. Valve seat dresser
   3. Valve seat wrench

INFORMATION SHEET

4. Set of hex wrenches (Allen wrenches)
5. Plumber's socket wrenches
6. Tubing tap and die set
7. Sink spray wrench

S. Caulking tools (Transparency 14)

1. Yarning iron
2. Inside caulking iron
3. Outside caulking iron
4. Caulking hammer
5. Packing iron
6. Cut-off chisel

T. Eye protection (Transparency 14)

1. Safety glasses
2. Goggles
3. Face shield

III. Use and care of tools

A. Handsaws (Transparency 1)

1. Saw blade should be kept dry and lightly oiled
2. If possible, a protective guard should be kept on the cutting edge when not being used
3. Most saws cut on the forward stroke; release downward pressure on the return (or back) stroke
4. Number of teeth per inch (points) indicate how fine a cut the saw will make (Figure 1)

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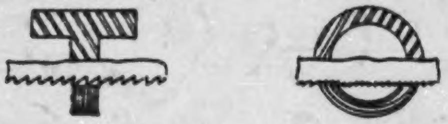
INFORMATION SHEET

(NOTE: At least two teeth should be on the work piece at all times while cutting.)

FIGURE 1



24 Teeth per inch

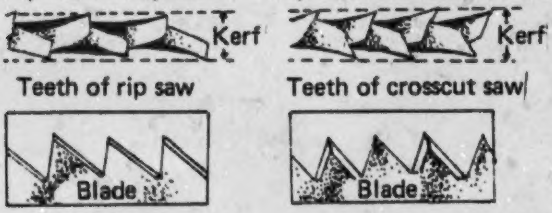
For angle iron, heavy pipe, brass, copper

32 Teeth per inch

For thin tubing

5. Type of saw tooth and set of tooth is important to the cut being made (Figure 2)

FIGURE 2


Top view of rip teeth
Top view of crosscut teeth
Kerf
Kerf
Teeth of rip saw
Teeth of crosscut saw
Blade
Blade

6. A used blade makes a more narrow cut than a new blade, therefore do not use a new blade in an old cut

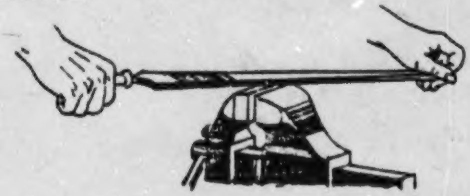
B. Files (Transparency 2)

1. Filing must be done flat, not in a "rocking" motion

2. Filing should be done in long, slow strokes; the harder the metal is, the slower the stroke should be

   (NOTE: Use the whole length of the file. See Figure 3)

   FIGURE 3

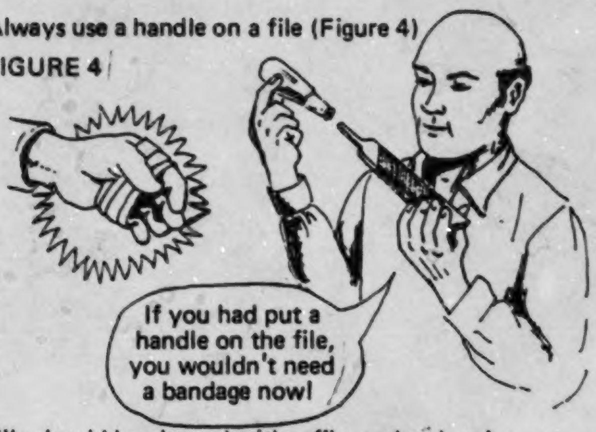


3. Files, like hacksaws, cut only on the forward stroke

   (NOTE: The cutting edges of the file can be worn down by applying too much pressure on the back stroke.)

4. Always use a handle on a file (Figure 4)

FIGURE 4


If you had put a handle on the file, you wouldn't need a bandage now!

5. File should be cleaned with a file card or brush

6. Rasps are wood files used to enlarge pipe holes

C. Measuring tools (Transparency 2)

1. Plumbing measurements must be accurate to the fraction of an inch and instruments must be capable of such accuracy

2. Folding rules should have a small amount of fine oil applied to the joints in order to lessen wear

   (NOTE: Loose joints can cause inaccuracies in measurement; each joint inaccuracy can multiply over the length of the rule.)

3. Joints can be loosened by dropping the rule on its end

4. Use care in handling wooden rules; they can break easily and are expensive

   (NOTE: Avoid buying cheap rules; they break very easily.)

5. Steel tapes must be kept clean and lightly oiled

   (NOTE: Dirt and other abrasives wear away the numbers and cause destruction of the rewinding mechanism.)

6. Rewinding tape slowly can avoid breakage and excessive wear

D. Levels (Transparency 3)

1. Vials (tubes) can easily be broken, causing the level to become useless

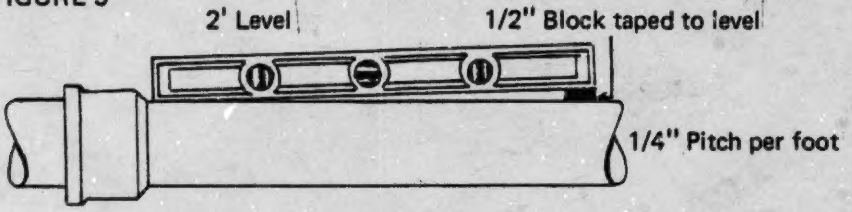
2. Occasionally run a flat file over the surface of a metal level to remove burrs

   (NOTE: Levels should be treated with so much care that no burrs ever develop.)

3. Wooden levels should be kept dry to avoid splinters and warping

4. Levels can be adjusted to determine correct pitch of drainage pipes (Figure 5)

FIGURE 5


2' Level
1/2" Block taped to level
1/4" Pitch per foot

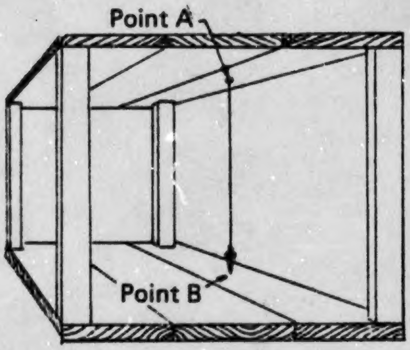
5. Torpedo levels are hand 9" levels which fit into a small tool box

(NOTE: Keep surfaces free of burrs to allow accurate readings.)

E. Plumb bob and line (Transparency 3)

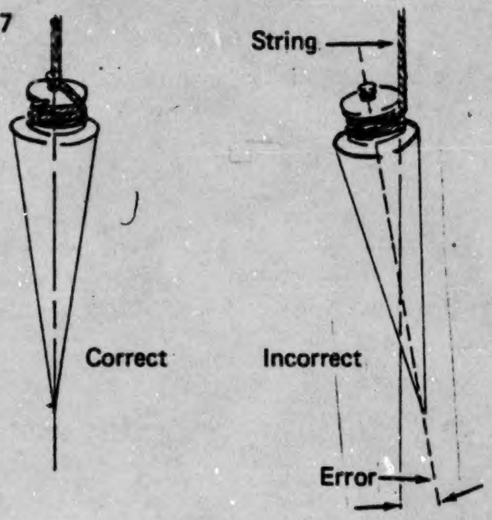
1. Used to locate the center of vertical runs and transfer the point from one floor level to another (Figure 6)

FIGURE 6


Point A
Point B

2. The point of the plumb bob must hang directly below the string in a vertical plane (Figure 7)

FIGURE 7



3. Rounded or bent points can cause inaccurate measurements

4. The line must be of good quality to avoid breakage or excessive wear

   (CAUTION: Do not look directly up at a hanging plumb bob or allow anyone else to do so.)

5. In order to establish an accurate measurement the following steps must be observed:

   a. The line must be stretched tightly

   b. The line must not be allowed to touch some object between the two points

   c. The plumb bob must not be swinging when the measurement is taken

   d. The plumb bob can rest on the surface, be lifted slightly, and then rest again to determine an accurate location

F. Chalk line (chalk box) (Transparency 3)

   1. Chalk lines must be kept dry

   2. Different colored chalk can be used for specific purposes

   3. The most common use is to lay out wall locations for piping installation

   4. The chalk box must be refilled with chalk periodically

INFORMATION SHEET

G. Chisels and punches (Transparency 4)

1. Cold chisels are used to cut cold metal and are made in a variety of shapes: flat, cape, diamond point, round nose

   (NOTE: The flat chisel is the most useful as a general purpose chisel.)

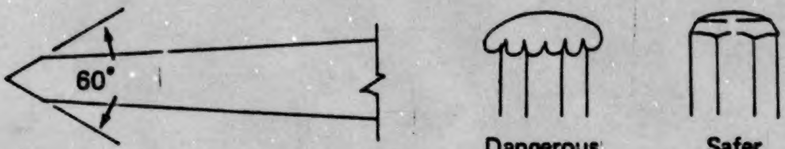
2. Chisels and hammers should be held loosely but firmly in order to "bounce" the chisel as it is struck

   (NOTE: Holding the chisel and hammer tightly will cause the worker to absorb the shock of the blow.)

3. Wear goggles when using chisels

4. The cutting edge of cold chisels should be kept sharp and the head clean and tapered (Figure 8)

FIGURE 8



Dangerous

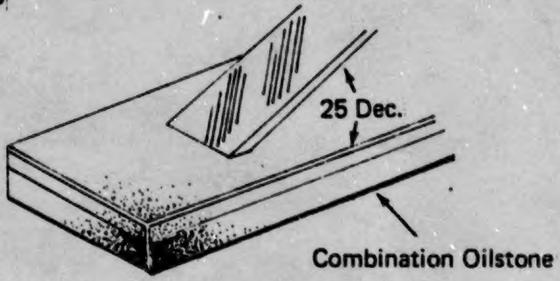
Safer

5. Steel chisels for wood can be purchased in sets or individually

6. Wood chisels are used to trim openings and make notches for pipe

7. Wood chisels are ground to a 25° angle and must be periodically honed and oiled in order to maintain a sharp edge (Figure 9)

FIGURE 9



8. Nail sets are useful to the plumber in various ways such as chipping glazed bathroom tile for screw holes when hanging lavatories

9. Pin punches of 1/8", 1/4" and 3/8" are useful to the plumber in punching holes in the metal or other material and in dislodging corroded parts

10. Center punches are used to make starting points for drilling metal

H. Drilling tools (Transparency 5)

1. Hand drilling machines are useful for small jobs when electricity is unavailable

2. A ratchet brace is especially useful when electricity is unavailable

   (NOTE: These tools must be cleaned and oiled after use.)

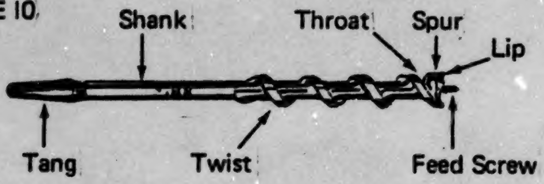
3. Small masonry drills 1/8" to 1/2" are valuable in drilling bathroom tile, and making holes in concrete for anchor bolts

4. High speed steel drills are useful in cleaning and enlarging holes in metal and other materials, and also for drilling new holes

   (NOTE: High speed steel (HSS) is used in the manufacture of these drills.)

5. Wood bits (auger bits) are designed to be used in a ratchet brace (Figure 10)

FIGURE 10



6. Expansive wood drills allow a variety of hole sizes to be drilled with a single drill

I. Wrenches (Transparencies 6 and 7)

1. Small pipe wrenches are handy for small pipe and round objects, especially in tight places

2. Offset pipe wrenches are useful in working in corners and other tight places

INFORMATION SHEET

3. Adjustable wrenches are useful because they can replace several different sizes of open end wrenches

   (NOTE: All wrenches should be kept dry and lightly oiled.)

4. Open-end wrenches are useful because they are not likely to slip off an object when being used

   (NOTE: Wrenches that have damaged or "spread" jaws should be discarded.)

5. Plier wrenches (vise grips) are always handy when square or hex shoulders have been worn away and when working in tight quarters

   (NOTE: Plier wrenches should not be used where scratches from jaw teeth create an unsightly installation.)

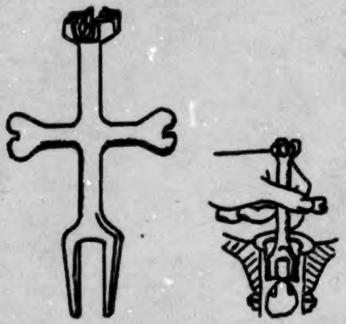
6. Flare nut wrenches are useful when tightening or loosening a flare nut because the end of the open end wrench can easily slip over the tubing

7. Socket wrenches are necessary when working with nuts and bolts where adjustable or open end wrenches cannot gain access

8. Spud wrenches are primarily used to hold slip nuts which have flat surfaces and/or require care in avoiding scratches

9. A plug wrench allows easy tightening of lavatory and bath drains by firmly holding the drain plug while the locknut is being tightened by a spud wrench (Figure 11)

   FIGURE II

10. A no-hub torque wrench is used to tighten stainless steel clamps on no-hub pipe connections

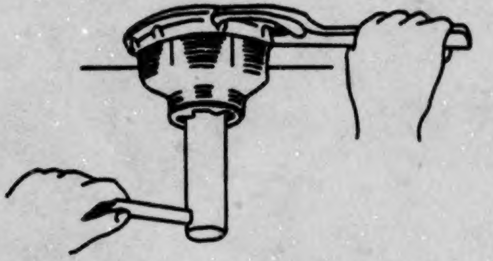
    (NOTE: Keep tools out of the dirt and clean and dry.)

11. Sink strainer wrench permits easy tightening of the sink strainer by holding the strainer firmly while tightening the locknut with a strainer locknut wrench.

INFORMATION SHEET

12. A strainer locknut wrench enables the plumber to easily tighten the large locknut beneath the sink strainer (Figure 12)

FIGURE 12

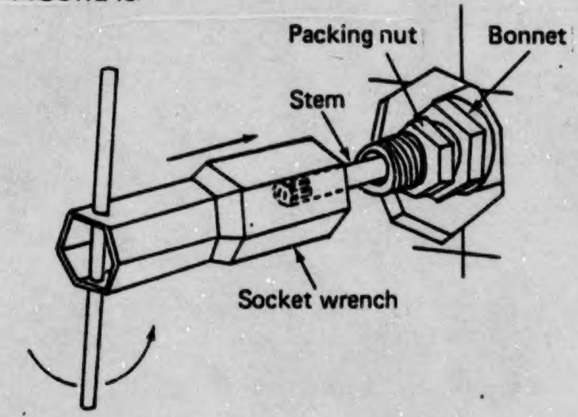


13. Plumber's sockets are necessary tools to remove the bonnet from tub and shower faucets in order to repair or replace the valve stem (Figure 13)

(NOTE: Neatly trim tile from around valve to allow access for socket wrench.)

(CAUTION: Always wear safety glasses.)

FIGURE 13

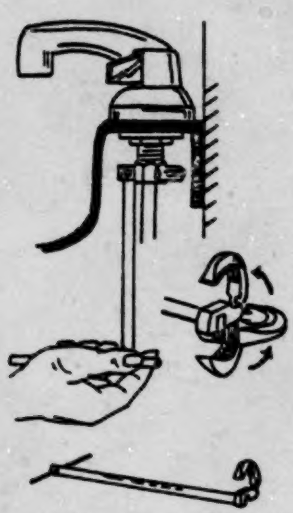


P-229-B

INFORMATION SHEET

14. A basin wrench is an absolute necessity for loosening and/or tightening locknuts and water supply connecting nuts on sink and lavatory faucets (Figure 14)

FIGURE 14



15. A strap wrench is used in place of a pipe wrench when scratches and other pipe wrench damage would affect the appearance of the installation

    (NOTE: Keep strap dry and free from oil.)

16. Internal wrenches are useful in installing close nipples without damage to threads

J. Pliers (Transparency 8)

1. Needlenose pliers are very helpful to the plumber in such instances as retrieving loose parts in a faucet and repairing drop lights and extension cords

   (NOTE: Pliers should be cleaned after each use and periodically oiled.)

2. Adjustable pliers are useful in turning difficult to open locknuts, bath and shower drains, and many other plumbing fittings

   (NOTE: Care should be taken to avoid scratching where appearance is important.)

K. Hammers and nail pullers (Transparency 9)

1. A claw hammer is a necessary tool when the plumber prepares a wood frame structure for piping installation or framing members might need to be moved or revised

   (CAUTION: Hammers with worn faces should not be used.)

INFORMATION SHEET

2. Ball peen hammers are ideal for caulking cast iron joints

   (NOTE: Hammers should be kept dry and clean.)

3. Nail pullers are very useful when moving studs, flooring, and other wood structure when destructive methods must be avoided

L. Screwdrivers (Transparency 8)

1. Phillips head screwdrivers are used in fixture installation since most screws on fixture trim are phillips head screws

   (NOTE: Discard worn phillips head screwdrivers.)

2. Straight tip screwdrivers are used for various jobs such as tightening clamps on flexible plastic pipe and fastening lavatory hangers onto walls

M. Tubing cutters (Transparency 10)

1. Plumbers should provide their own cutters to cut tubing up to and including 2", and the employer should, when necessary, provide larger cutters

   (NOTE: Cutting wheels and rollers should be oiled periodically and cutting wheels replaced when needed.)

2. Close tubing cutters are available for cutting tubing in close quarters

N. Copper tubing tools (Transparency 11)

1. Strikers, which provide sparks for torch lighting, should be kept dry, clean, and free from oil

   (NOTE: Extra flints for the striker should be kept in the tool box.)

2. Flux brushes are helpful in making a clean application of flux to pipe and fitting

   (NOTE: Special flux brushes are availabe at stores, or old tooth brushes can be used.)

3. A good supply of clean wiping cloths should be available to the worker for cleaning pipes and soldered joints

4. Sand cloth, emery paper, or steel wool is necessary to clean oxidized surfaces of copper pipe and fittings prior to applying flux

P-231-B

5. A pocket knife is used for reaming large size copper tubing and plastic pipe, cutting flexible plastic pipe, and many other uses

   (CAUTION: Carelessness in using a pocket knife has caused many injuries and lost work hours.)

6. Flaring tools, which are used for making mechanical joints, should be cleaned and oiled after use

7. Hammer flaring tools are used to make joints on water service lines and other plumbing connections

   (NOTE: Keep tool clean and lightly oiled at all times.)

8. Swaging tools save the expense of fittings by enlarging tubing ends to act as couplings

   (NOTE: Keep tool clean and lightly oiled at all times.)

9. Fitting brushes do an excellent job of cleaning small fittings in preparation for soldering

   (NOTE: Turn fitting brushes in clockwise direction as counterclockwise will reduce the effectiveness of the brushes.)

10. Tubing benders should be returned to their proper places immediately after use

O. Snips (Transparency 12)--Snips (straight aviation types are best) are a useful tool to the plumber in performing jobs such as cutting vent pipe

(NOTE: Do not cut wire with snips.)

P. Pipe taps (Transparency 12)

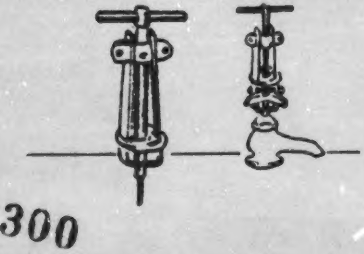
1. Pipe taps are used to repair damaged threads

2. Keep taps clean and oiled at all times.

Q. Faucet and toilet tank repair tools (Transparency 3)

1. A handle puller should be in every plumber's tool box since considerable damage to valves and faucets can be done by using crude methods (Figure 1)

FIGURE I

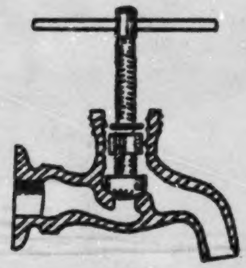


INFORMATION SHEET

2. Valve seat dressers are used to remove worn surfaces and burrs from valve seats (Figure 15)

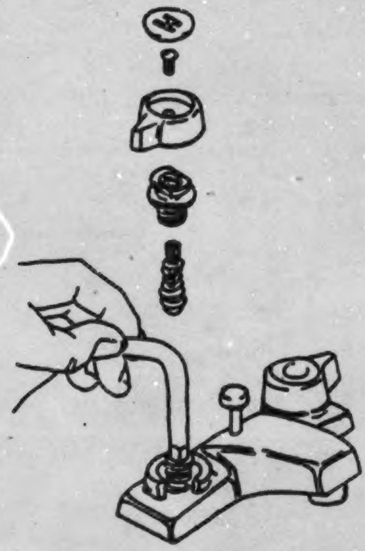
   (NOTE: Keep cutting edges clean and the whole tool lightly oiled.)

   FIGURE 15



3. Valve seat wrenches are used to remove valve seats that need to be replaced (Figure 16)

   FIGURE 16



4. Hex wrenches (Allen wrenches) have many uses for the plumber, but the most common is working on faucet repairs

5. Plumber's socket wrenches are necessary when doing repair work

   (NOTE: See "wrenches," number 13, this unit.)

F. 233-R

6. A tubing tap and die set is a valuable tool when repairing water closet ball cocks

R. Putty knives (Transparency 12)--Putty knives have many uses including grouting the base of water closets and removing or reshaping water closet wax rings

S. Caulking tools (Transparency 14)--Caulking tools are used to make lead joints on cast iron pipe

(NOTE: All plumber's should carry a yarning iron, packing iron, and inside and outside caulking irons.)

T. Eye protection (Transparency 4)

1. Safety glasses are special glasses approved by the Federal Food and Drug Administration (FDA) after passing an impact resistance test; they are shatterproof and the frames are stronger

(NOTE: Safety glasses can be identified by manufacturer's symbols on both the lenses and frames.)

2. Goggles are made of a flexible plastic body and lens and provide protection from dust, flying particles, and splashed liquids

(CAUTION: Goggles must be worn over prescription lenses.)

3. Face shields protect the whole face from flying chips and splashed liquids

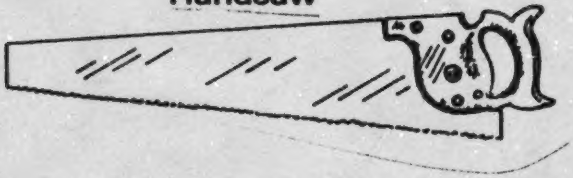
(CAUTION: Face shields should be worn in addition to goggles or safety glasses.)

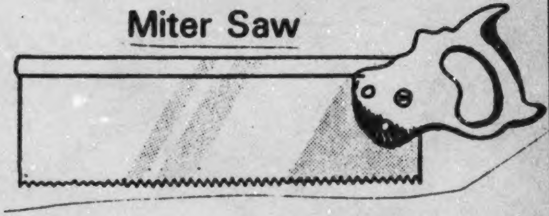
IV. Safety precautions while handling tools

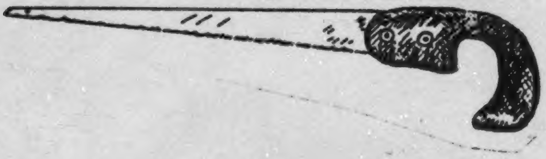
A. Condition of tools

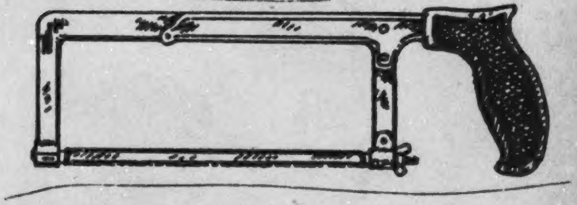
1. Tools should be kept clean
2. Tools should be free of grease and excess oil
3. Tool which can rust should be lightly oiled
4. Keep handles on files
5. Keep chisel ends trimmed and dressed
6. Drop cords and extension cords should be in good repair
7. Cutting tools should be kept sharp in order to prevent forcing or causing the worker to become impatient
8. Do not use a weak or damaged ladder

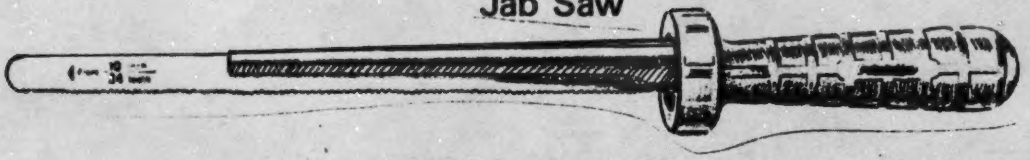
Types of Handsaws


Handsaw


Miter Saw

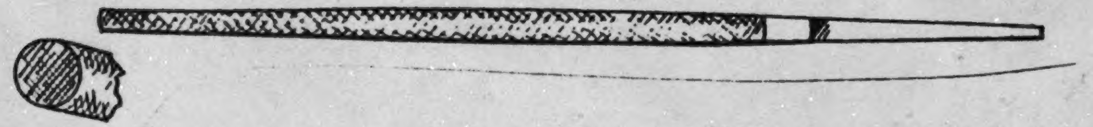

Compass or Keyhole Saw


Hacksaw

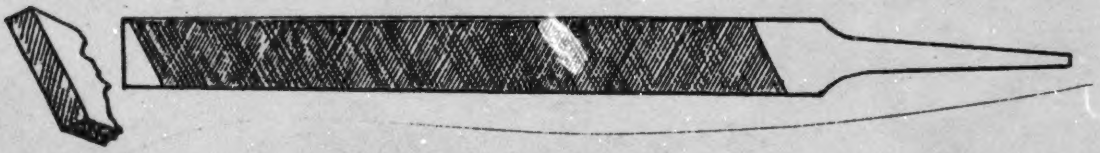

Jab Saw

Files and Measuring Tools

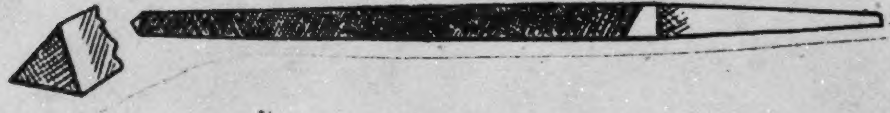
Round



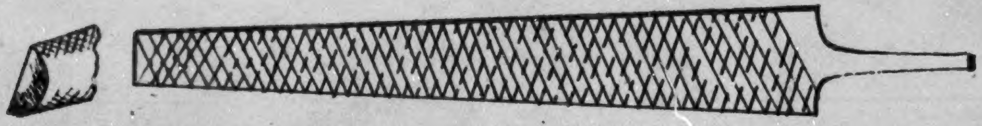
Flat

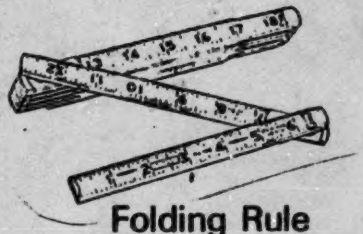


Triangular

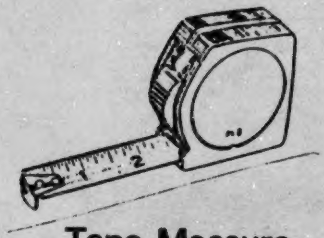


Rasp





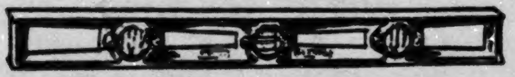
Folding Rule



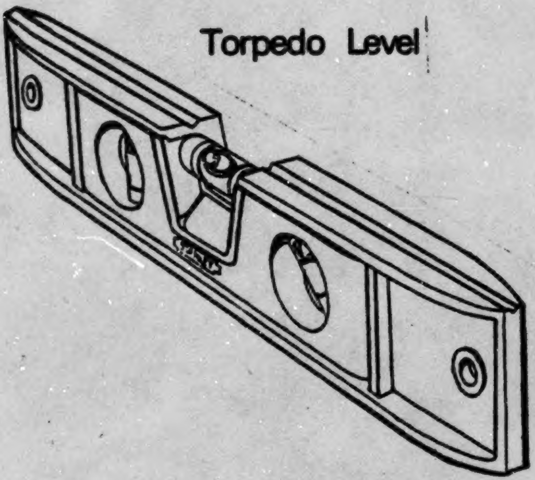
Tape Measure

Levels, Plumb Bob, and Chalk Line

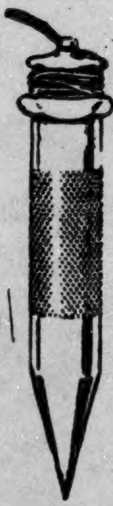
24" Carpenter's Level



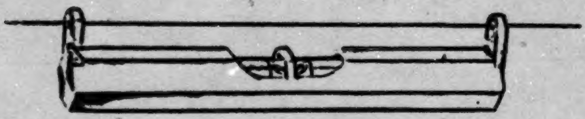
Torpedo Level



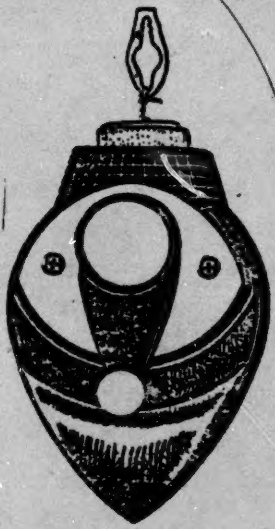
Plumb Bob
and Line



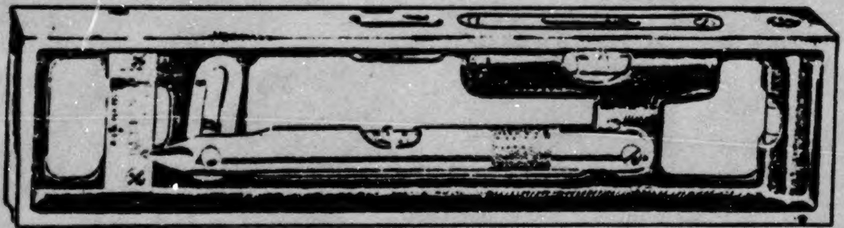
Line Level



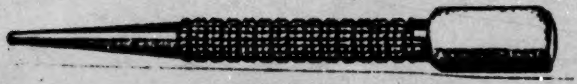
Chalk Line



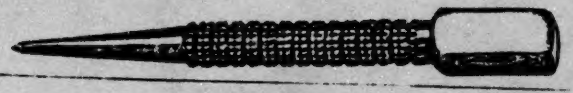
Plumber's Level



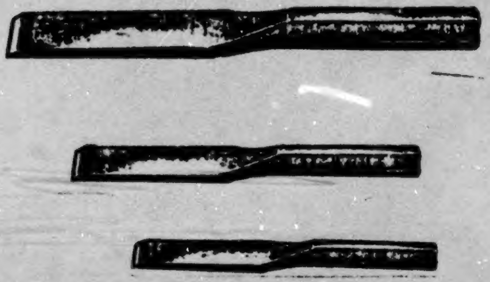
Chisels and Punches



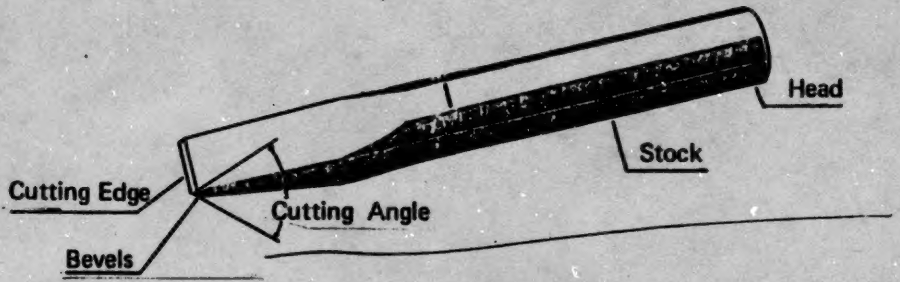
Nail Set



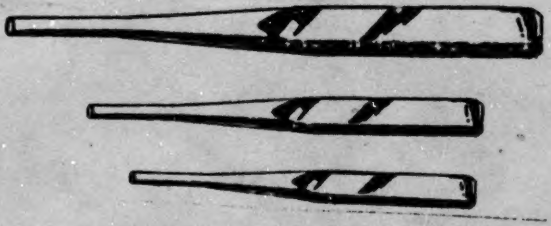
Center Punch



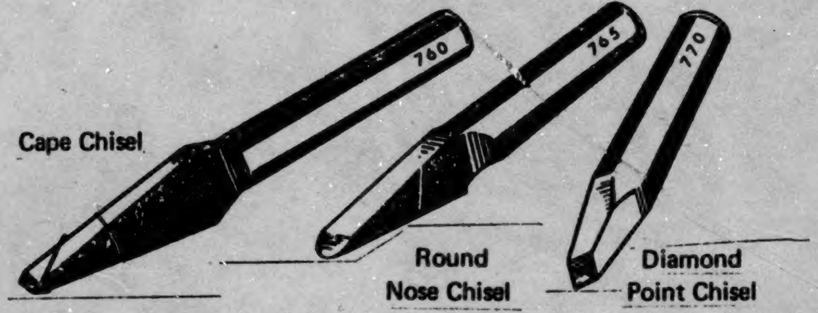
Set of Wood Chisels


Head
Stock
Cutting Edge
Cutting Angle
Bevels

Parts of a Cold Chisel



Set of Pin Punches

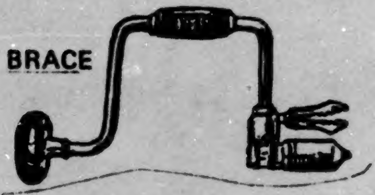

760
765
770
Cape Chisel
Round Nose Chisel
Diamond Point Chisel

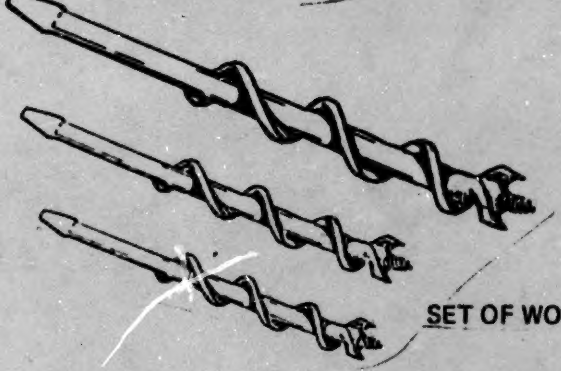
Set of Cold Chisels

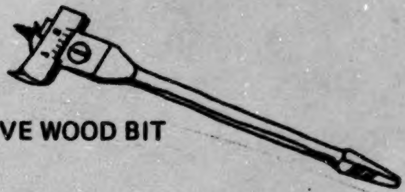
Illustrations of nail set, center punch, and cold chisels courtesy of Stanley Tools.

Drilling and Boring Tools

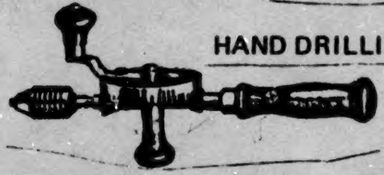
Boring Tools

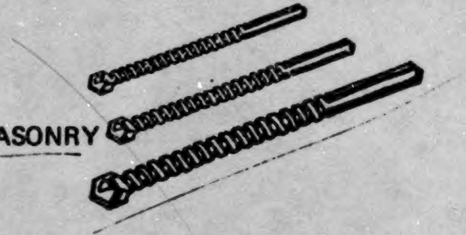

RATCHET BRACE

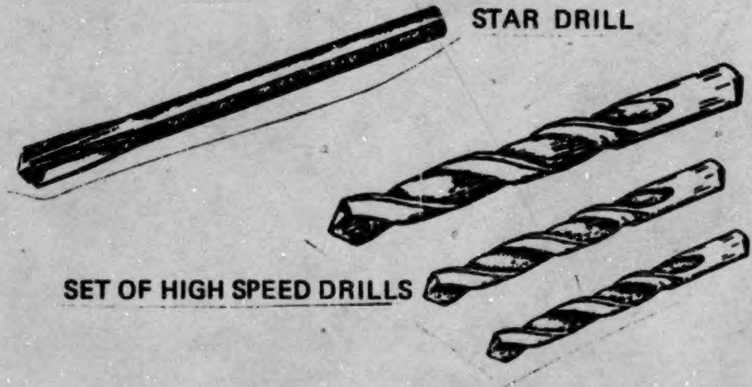

SET OF WOOD BITS


EXPANSIVE WOOD BIT

Drilling Tools

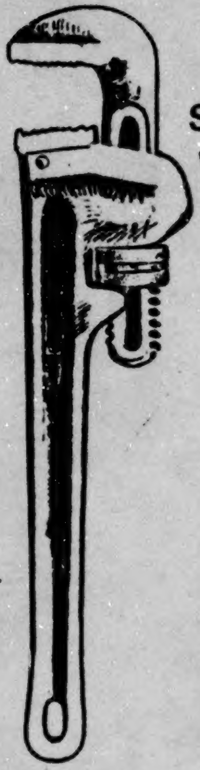

HAND DRILLING MACHINE


SET OF SMALL MASONRY DRILLS


STAR DRILL

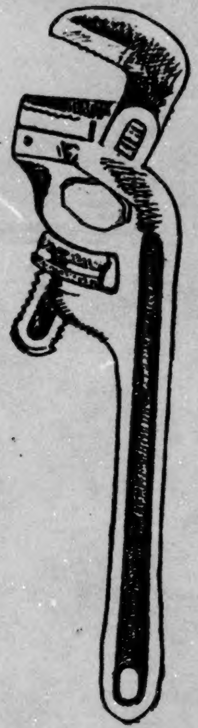
SET OF HIGH SPEED DRILLS

Wrenches

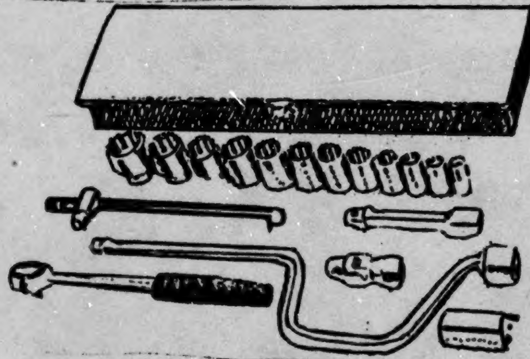


Straight Pipe Wrench

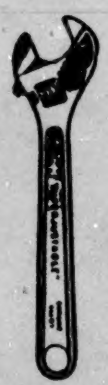
Flare Nut Wrenches



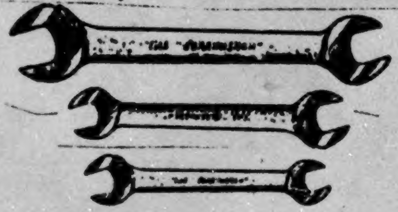
14" Offset Pipe Wrench



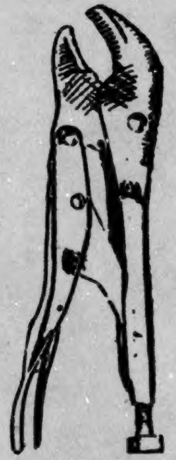
Set Of Socket Wrenches and Ratchet



8" Adjustable Wrench



Set of Open-End Wrenches



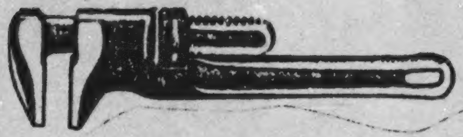
8" Plier Wrench

(Vise Grips)

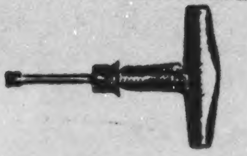
Wrenches

(Continued)

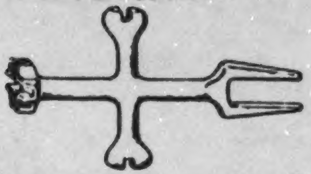
12" Spud Wrench



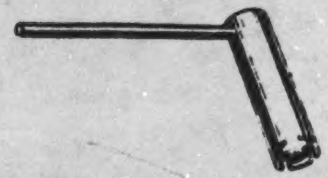
No-Hub Torque Wrench

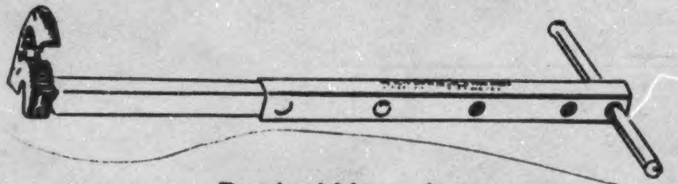


Plug Wrench



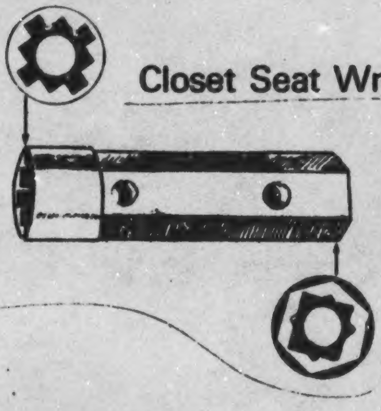
Sink Strainer Wrench



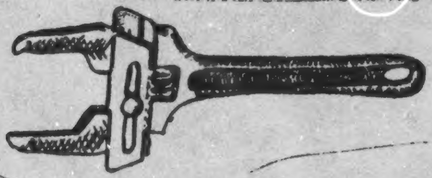


Basin Wrench

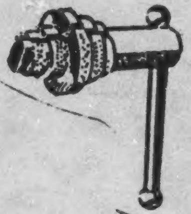
Closet Seat Wrench



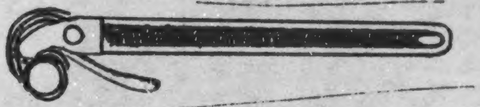
All-Purpose Wrench



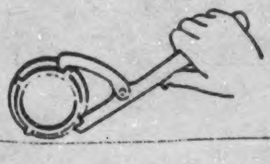
Internal Wrench



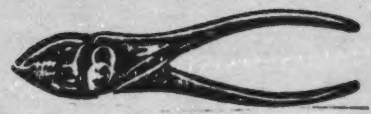
Strap Wrench



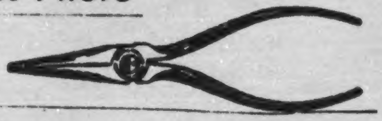
Strainer Lock-Nut Wrench



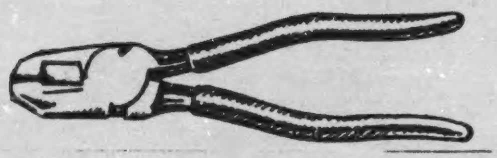
Screwdrivers and Pliers



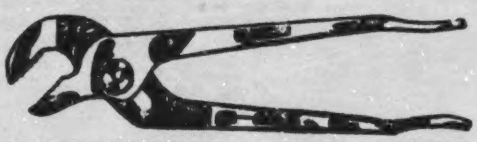
Combination Slip-Joint Pliers



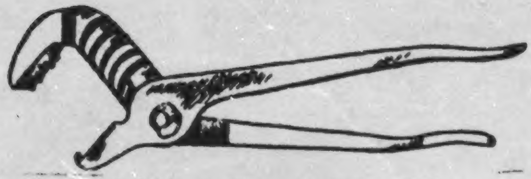
Needlenose Pliers



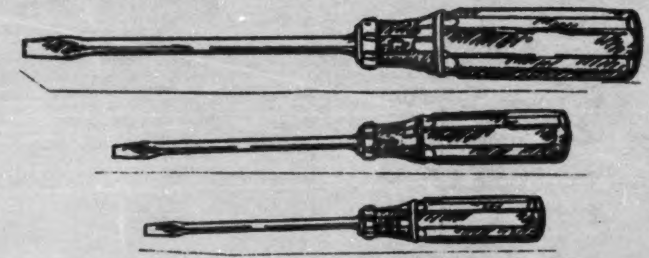
Dykes (Lineman's Pliers)



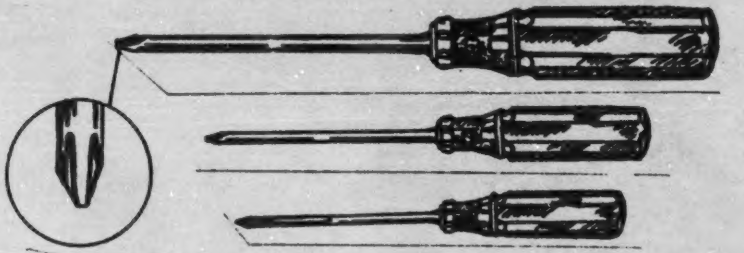
10" Adjustable Pliers



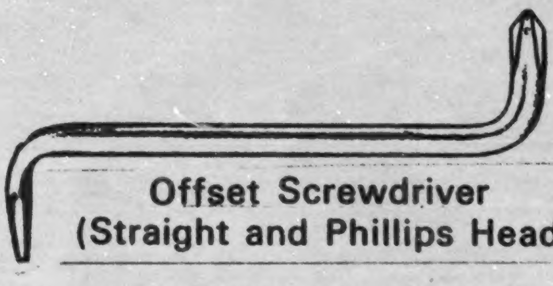
14" Adjustable Pliers



Set of Straight Tip Screwdrivers

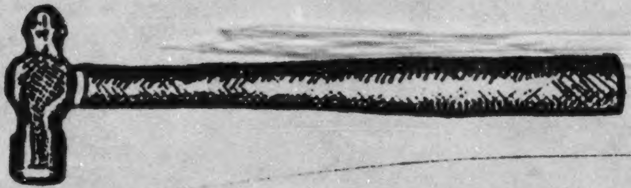


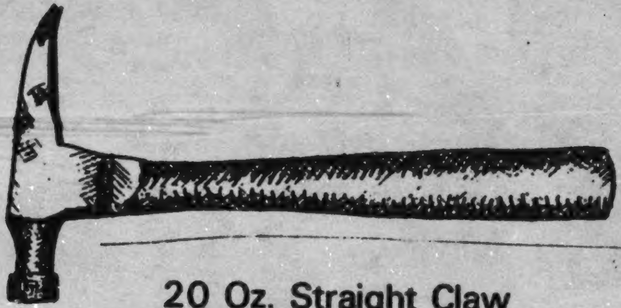
Set of Phillips Head Screwdrivers

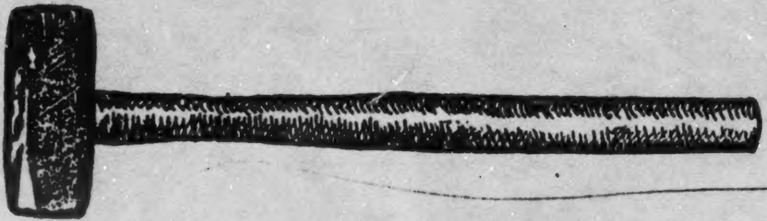


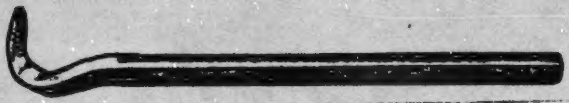
Offset Screwdriver
(Straight and Phillips Head)

Hammers

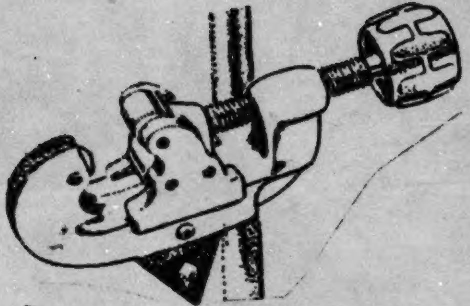

16 Oz. Ball Peen


20 Oz. Straight Claw

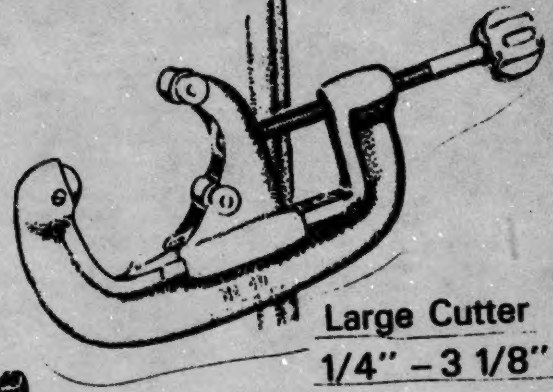

Sledge Hammer


Nail Puller (Cat's-Paw)

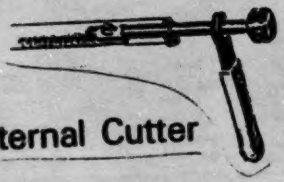
Tubing Cutters



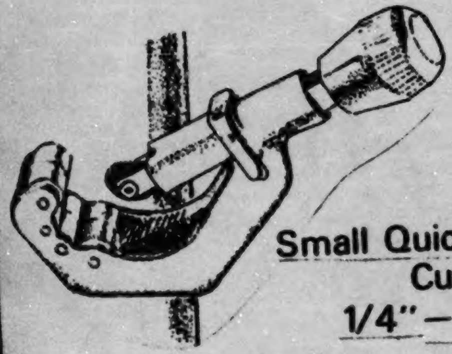
Small Diameter Cutter
1/8"–1"



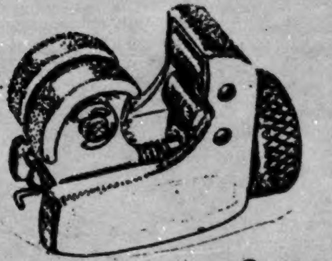
Large Cutter
1/4" – 3 1/8"



Internal Cutter

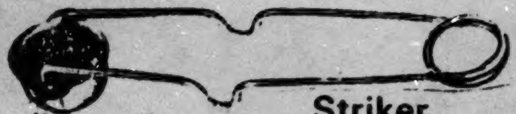


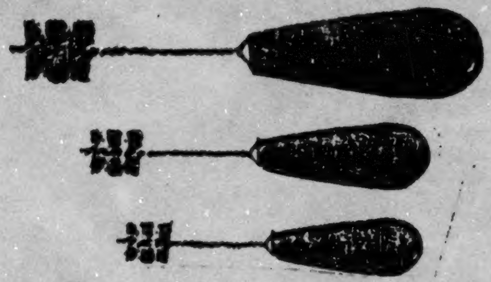
Small Quick-Opening
Cutter
1/4" – 1 1/8"

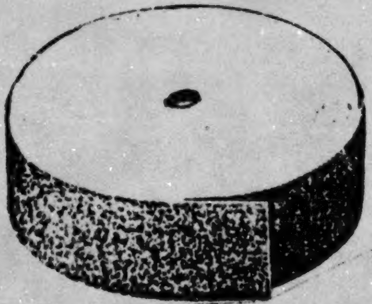


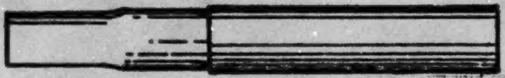
Close Tubing Cutter
(Mini-Cutter)
1/2"–3/4"

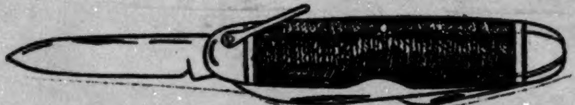
Copper Tubing Tools

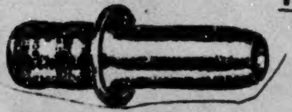

Striker

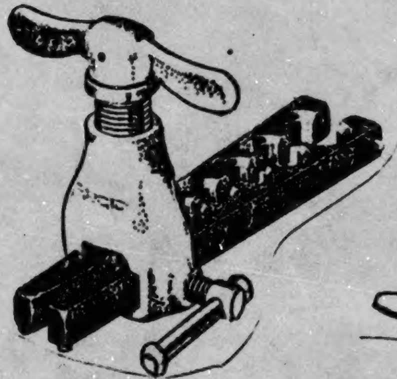

Set of Copper Fitting Brushes


Sandcloth

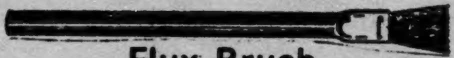

Swaging Tool

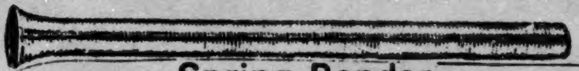

Pocket Knife

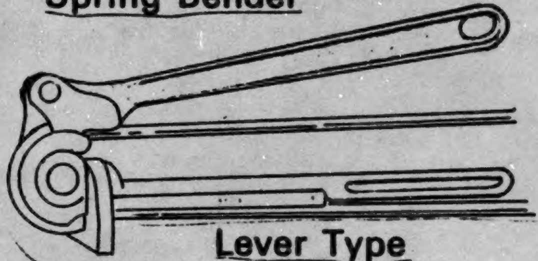

Flaring Tool Hammer Type

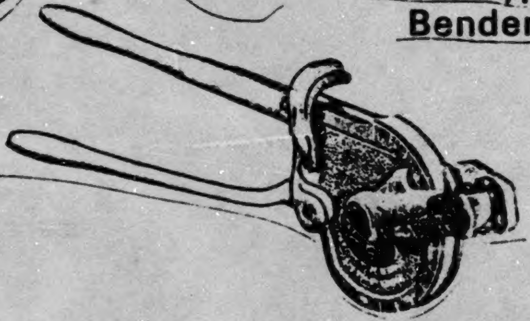

Yoke and Screw Flaring Tool

Shop Towel

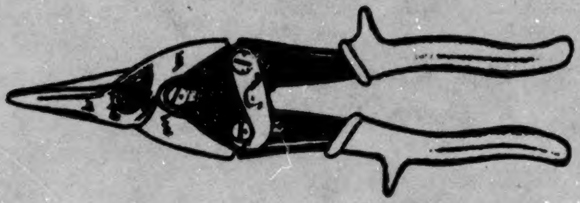

Flux Brush


Spring Bender

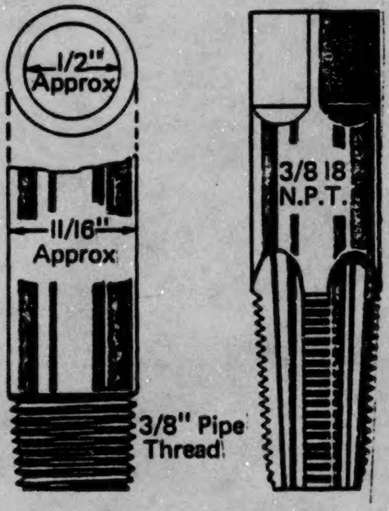

Lever Type Bender


Geared Ratchet Type Bender

Straight Snips, Pipe Taps, and Putty Knife



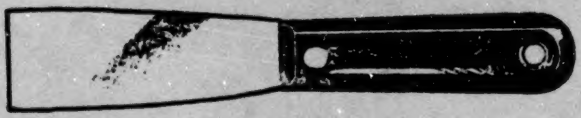
Pair of Straight Snips


1/2"
Approx
11/16"
Approx
3/8" Pipe
Thread
3/8 18
N.P.T.

3/8" Pipe

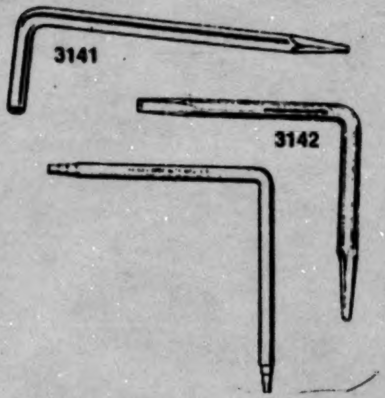
3/8" Pipe Tap
44.154

Pipe Taps

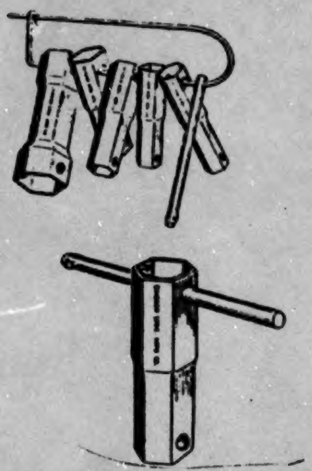


Putty Knife

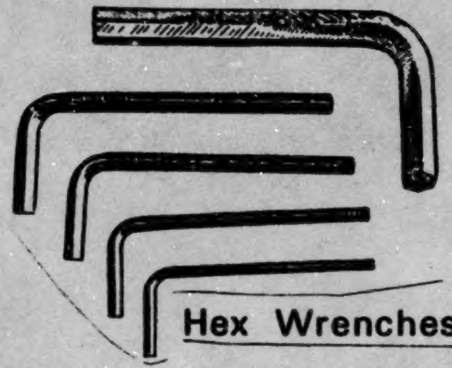
Faucet and Toilet Tank Repair Tools



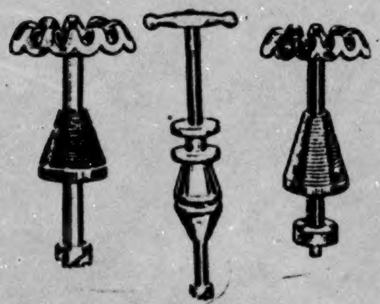
Valve Seat Wrenches



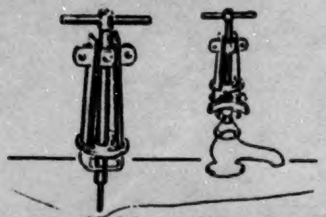
Plumber's Socket Wrenches



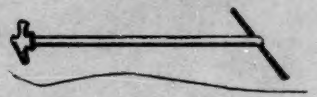
Hex Wrenches



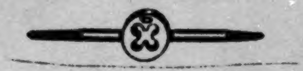
Valve Seat Dressers



Faucet Handle Puller

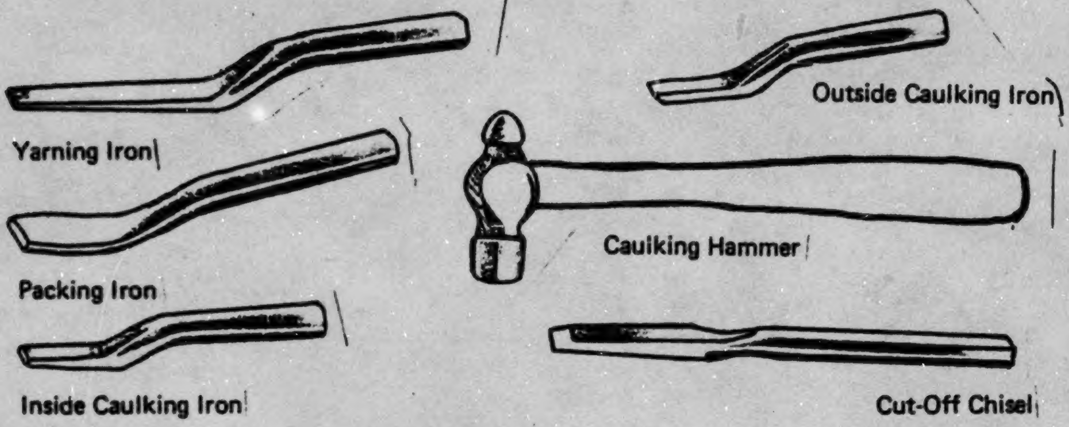


Sink Spray Wrench

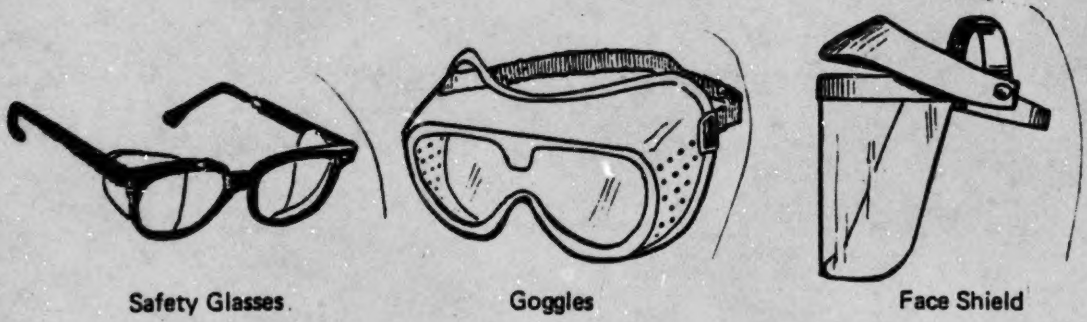


Tubing Tap and Die Set

Caulking Tools And Eye Protection


Outside Caulking Iron
Yarning Iron
Caulking Hammer
Packing Iron
Inside Caulking Iron
Cut-Off Chisel

Caulking Tools


Safety Glasses
Goggles
Face Shield

Eye Protection

PLUMBER'S TOOL BOX
UNIT IV

NAME ______________________

TEST

1. Match terms on the right to the correct definitions.

_____a. Those tools, including special tools, which are used primarily for reconditioning of piping systems, valves, faucets, fixtures, and other components

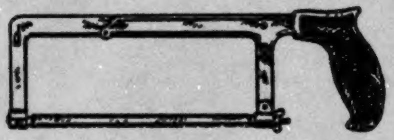
_____b. General construction tools which consist of small tools provided by the worker and more expensive tools provided by the employer

_____c. Expensive tools or tools used for a specific purpose, usually provided by the employer

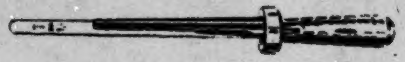
_____d. Hand held tools used for common plumbing jobs, usually owned by the plumber

1. Installation tools
2. Specialty tools
3. Repair tools
4. Hand tools

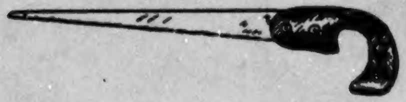
2. Identify tools usually found in a plumber's tool box.



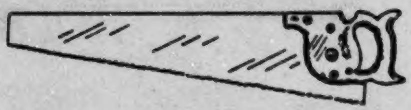
a. ______________________



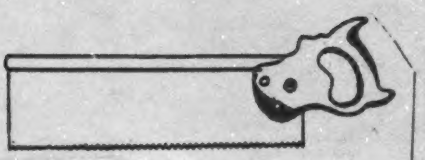
b. ______________________

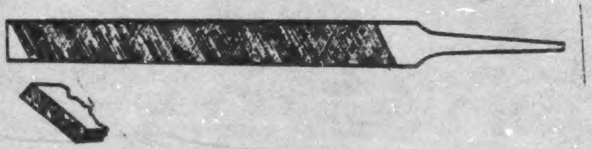


c. ______________________

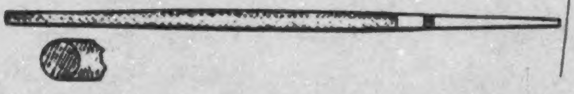


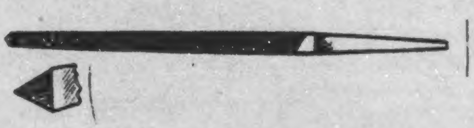
d. ______________________



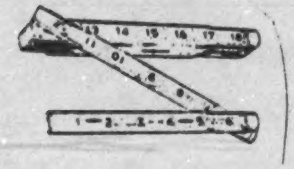


e. ____________________ f. ____________________





g. ____________________ h. ____________________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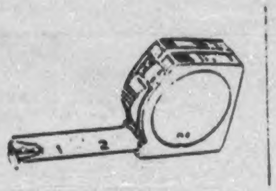
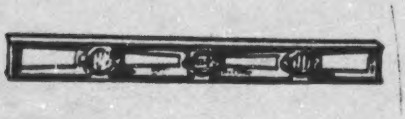
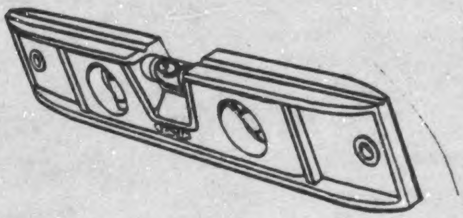


i. ____________________ j. ____________________





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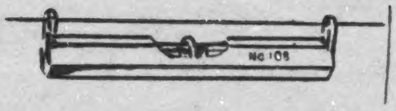

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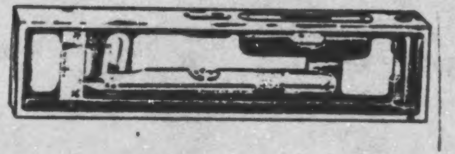

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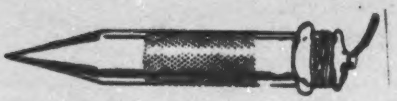

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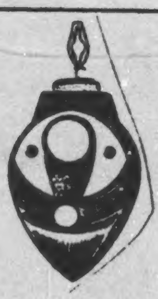

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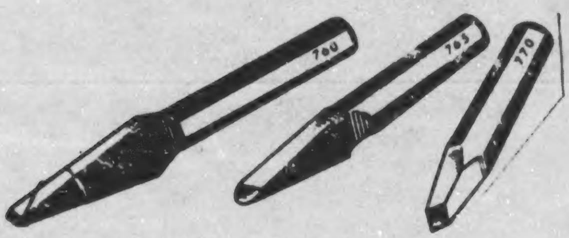

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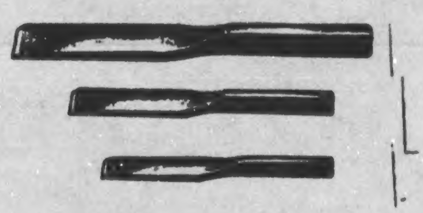

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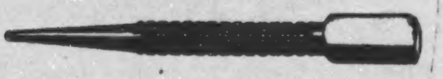

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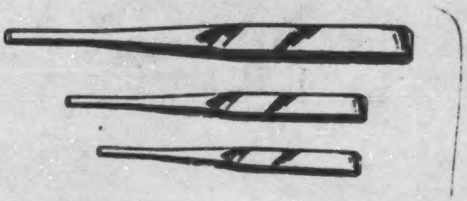

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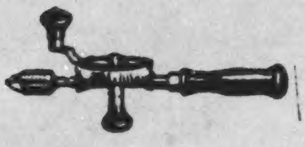

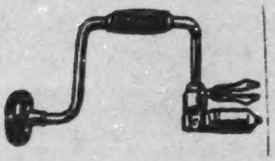

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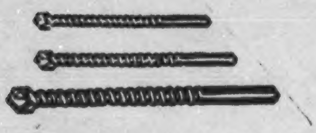

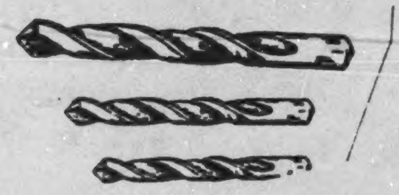

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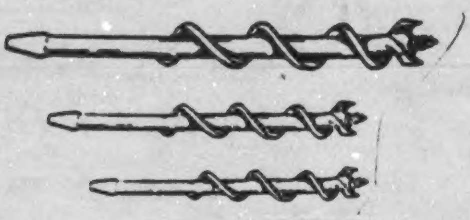

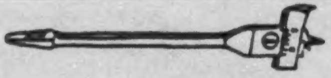

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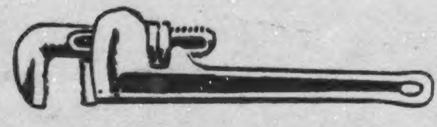

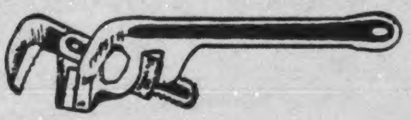

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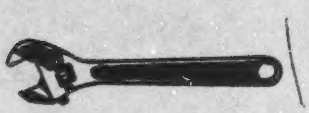

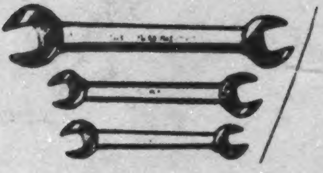

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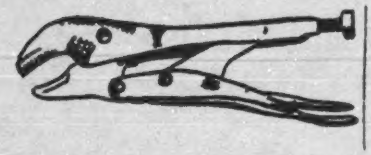

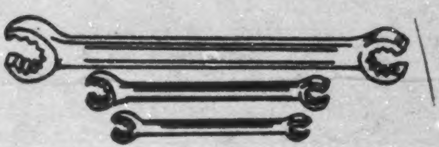

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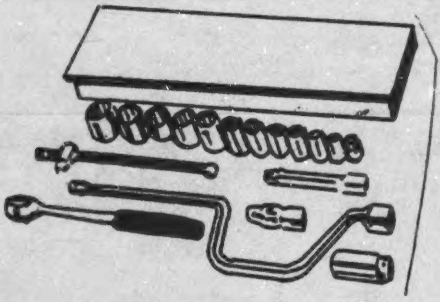

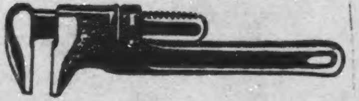

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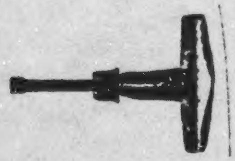

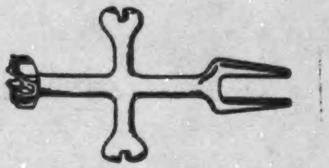

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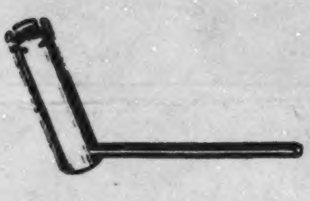
jj. ______________________

P-269 E



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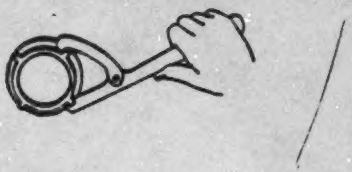

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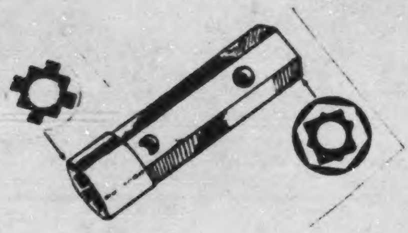

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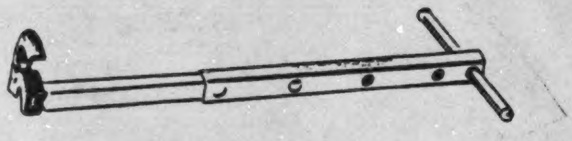

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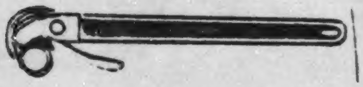

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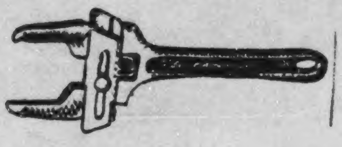

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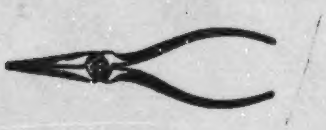

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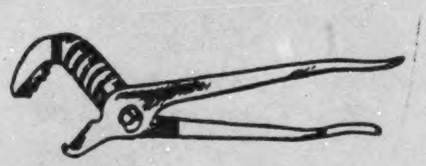

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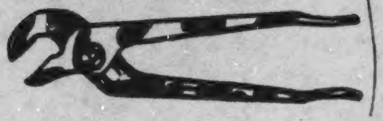

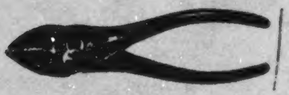

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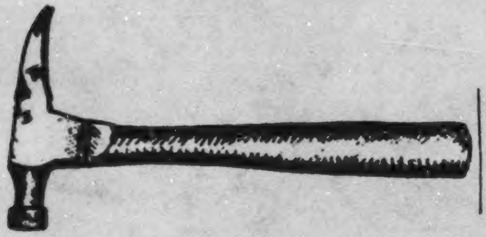

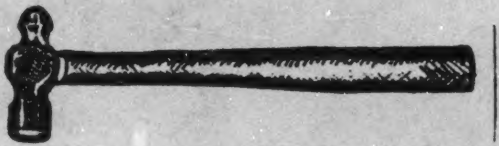

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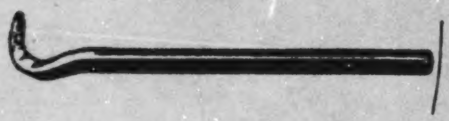

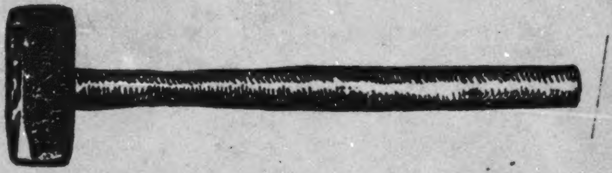

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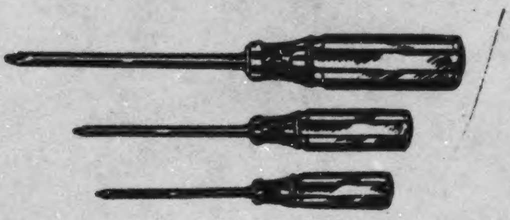

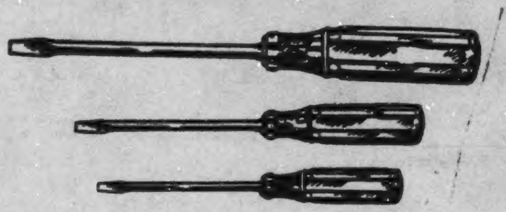

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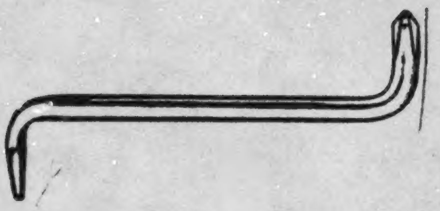

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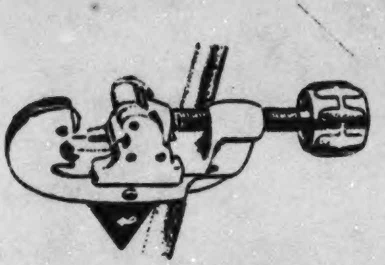

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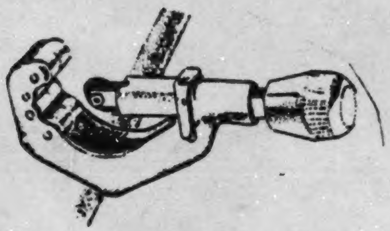

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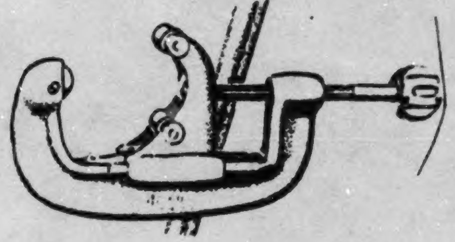

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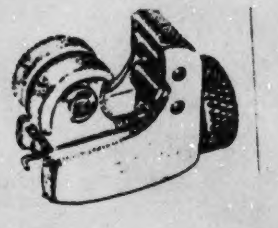

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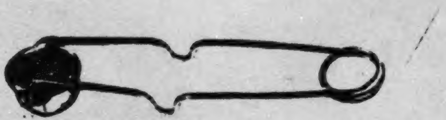

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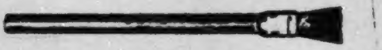

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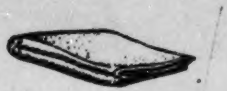

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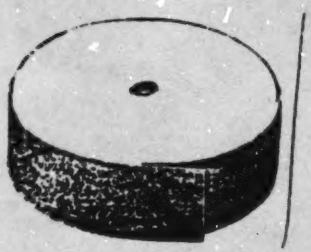

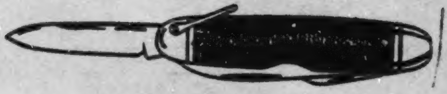

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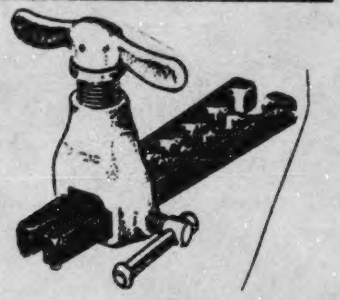

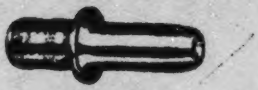

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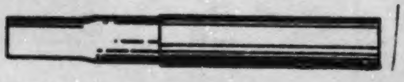

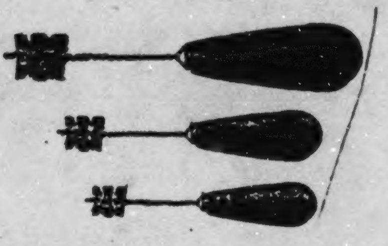

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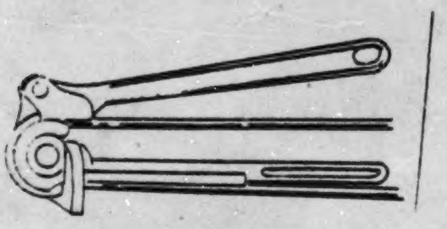

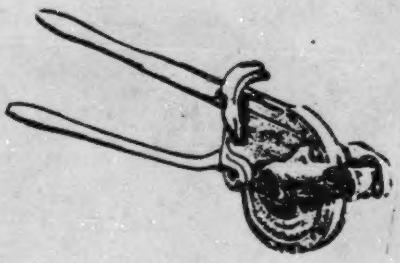

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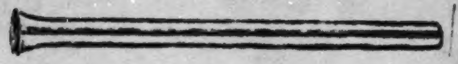

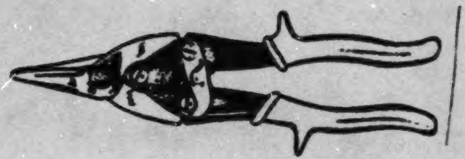

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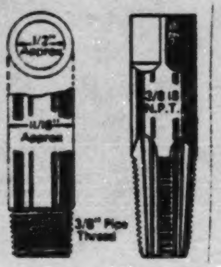
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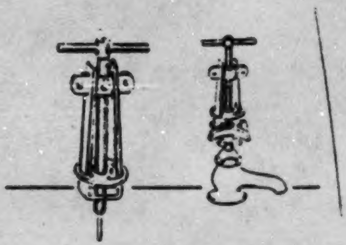
11/16" Approx
3/8" Pipe Thread
3/8 18 N.P.T.



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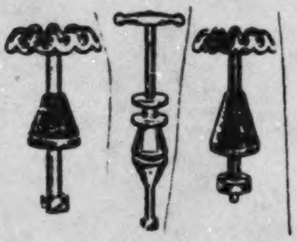

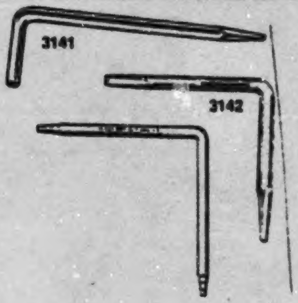

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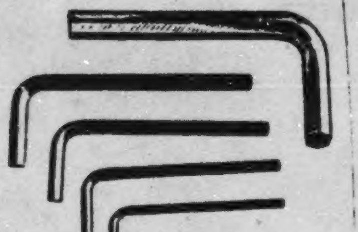

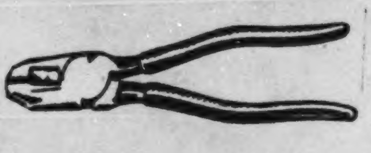

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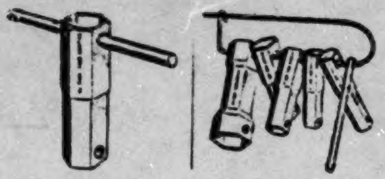

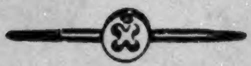

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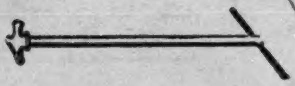

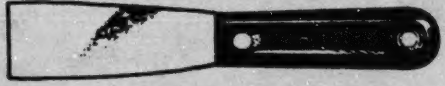

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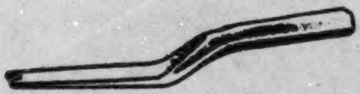

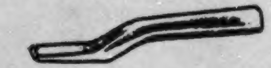

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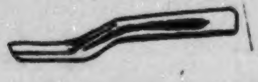

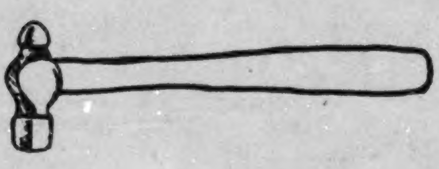

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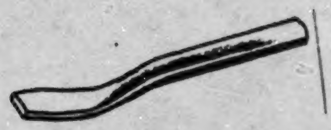

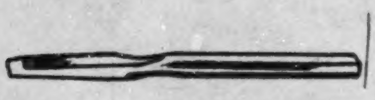

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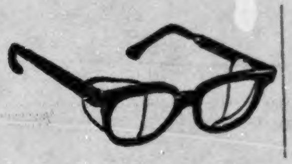

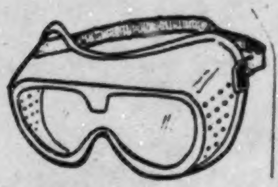

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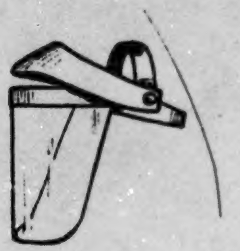

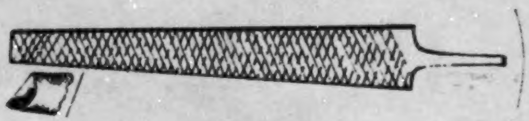

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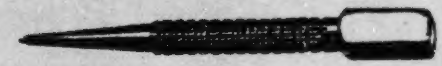

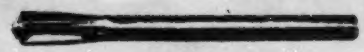

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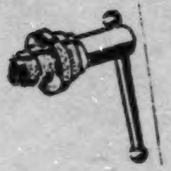

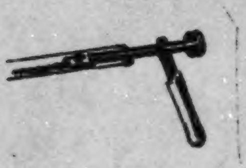

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3. Select true statements about the use and care of tools usually found in a plumber's tool box by placing an "X" in the appropriate blanks.

_____a. Saw blade should be kept dry and lightly oiled

_____b. Number of teeth per inch (point) indicate how fine a cut the saw will make

_____c. Filing should be done in a "rocking" motion

_____d. Always use a handle on a file

_____e. Folding rules should have a small amount of fine oil applied to the joints in order to lessen wear

_____f. Steel tapes should be rewound with great speed

_____g. Occasionally run a flat file over the surface of a metal level to remove burrs

_____h. Levels can be adjusted to determine correct pitch of drainage pipes

_____i. Plumb bobs are used to locate the center of vertical runs and transfer the point from one floor level to another

_____j. The point on a plumb bob should be rounded or bent

_____k. A chalk line should use only white chalk

_____l. Chalk lines must be kept dry

_____m. Chisels and hammers should be held loosely but firmly in order to "bounce" the chisel as it is struck

_____n. Wood chisels are ground to a 90° angle and must be periodically honed and oiled in order to maintain a sharp edge

_____o. Hand drilling machines are useful for small jobs when electricity is unavailable

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_____p. High speed steel drills are useful in cleaning and enlarging holes in metal and other materials, and also for drilling new holes

_____q. Offset wrenches are handy for small pipe and round objects, especially in tight places

_____r. Open-end wrenches are useful because they are not likely to slip off an object when being used

_____s. Plug wrenches are primarily used to hold slip nuts

_____t. Needlenose pliers are useful in turning difficult to open locknuts, bath and shower drains, and many other plumbing fittings

_____u. Ball peen hammers are ideal for caulking cast iron joints

_____v. Nails pullers are useful when removing studs

_____w. Strikers should be kept dry, clean, and free from oil

_____x. A pocket knife is used for reaming large size copper tube and plastic pipe

_____y. Swaging tools are used to make tubing ends smaller

_____z. Handle pullers are used to remove worn surfaces and burrs from valve seats

_____aa. Valve seat wrenches are used to remove valve seats that need to be replaced

_____bb. A tubing tap and die set is a valuable tool when repairing water closet ball cocks

_____cc. Putty knives have many uses including grouting the base of water closets and removing or reshaping water closet wax rings

_____dd. Goggles protect the whole face from flying chips and splashed liquids

4. List safety precautions applied to the use of tools usually found in a plumber's tool box; list three items under each area.

   a. Condition of tools

      1)

      2)

      3)

   b. Work area

      1)

2)

3)

c. Handling tools

1)

2)

3)

d. Storing tools

1)

2)

3)

PLUMBER'S TOOL BOX
UNIT IV

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 2
   d. 4
2. a. Hacksaw
   b. Jabsaw
   c. Compass or keyhole saw
   d. Handsaw
   e. Miter saw
   f. Flat file
   g. Round file
   h. Triangular file
   i. Folding rule
   j. Tape measure
   k. 24" carpenter's level
   l. Torpedo level
   m. Line level
   n. Plumber's level
   o. Plumb bob and line
   p. Chalk line
   q. Set of cold chisels
   r. Set of wood chisels
   s. Nail set
   t. Set of pin punches

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u. Hand drilling machine

v. Ratchet brace

w. Set of small masonry drills

x. Set of small high speed drills

y. Set of wood bits

z. Expansive wood bit

aa. Straight pipe wrench

bb. 14" offset pipe wrench

cc. 8" adjustable wrench

dd. Set of open end wrenches

ee. 8" plier wrench (vise grips)

ff. Set of flare nut wrenches

gg. Set of socket wrenches and ratchet

hh. 12" spud wrench

ii. No-hub torque wrench

jj. Plug wrench

kk. Sink strainer wrench

ll. Strainer locknut wrench

mm. Closet seat wrench

nn. Basin wrench

oo. Strap wrench

pp. All-purpose wrench

qq. Needlenose pliers

rr. 14" adjustable pliers

ss. 10" adjustable pliers

tt. Combination slip-joint pliers

uu. 20 oz. straight claw hammer

vv. 16 oz. ball peen hammer

ww. Nail puller (cats-paw)
xx. Sledge hammer
yy. Set of phillips head screwdrivers
zz. Set of straight tip screwdrivers
aaa. Offset screwdriver
bbb. Small diameter tubing cutter (1/8" - 1")
ccc. Small quick opening tubing cutter (1/4" - 1 1/8")
ddd. Large tubing cutter (1/4" - 3 1/8")
eee. Close tubing cutter (1/2", 3/4")
fff. Striker
ggg. Flux brush
hhh. Clean towel
iii. Sandcloth
jjj. Pocket knife
kkk. Yoke and screw flaring tool
lll. Hammer flaring tool
mmm. Swaging tool
nnn. Set of copper fitting brushes
ooo. Lever type tubing bender
ppp. Geared ratchet type tubing bender
qqq. Spring bender
rrr. Pair of straight snips
sss. Pipe taps (1/8" - 1")
ttt. Faucet handle puller
uuu. Valve seat dresser
vvv. Valve seat wrenches
www. Set of hex wrenches (Allen wrenches)
xxx. Dykes (lineman's pliers)

yyy. Plumber's socket wrenches

zzz. Tubing tap and die set

aaaa. Sink spray wrench

bbbb. Putty knife

cccc. Yarning iron

dddd. Inside caulking iron

eeee. Outside caulking iron

ffff. Caulking hammer

gggg. Packing iron

hhhh. Cut-off chisel

iiii. Safety glasses

jjjj. Goggles

kkkk. Face shield

llll. Rasp

mmmm. Center punch

nnnn. Star drill

oooo. Internal wrench

pppp. Internal cutter

3. a, b, d, e, g, h, i, l, m, o, p, r, u, v, w, x, aa, bb, cc

4. Any three under each area:

   a. Condition of tools

      1. Tools should be kept clean
      2. Tools should be free of grease and excess oil
      3. Tools which can rust should be lightly oiled
      4. Keep handles on files
      5. Keep chisel ends trimmed and dressed
      6. Drop cords and extension cords should be in good repair
      7. Cutting tools should be kept sharp in order to prevent forcing or causing the worker to become impatient
      8. Do not use a weak or damaged ladder

b. Work area

1. Keep work area clean
2. Carry to the work area only those tools that you will need
3. Lay out your tools in an orderly fashion
4. Provide ample room to work; do not struggle around objects which can be moved
5. Keep such items as gas hoses and electric cords neat and orderly and not in a tangled mess
6. Clean the work area before leaving

c. Handling tools

1. Keep tools in their proper places
2. Sharp instruments such as screwdrivers should not protrude from pockets
3. Tools should be handed to one another, not thrown or tossed
4. Electric cords should be kept out of water
5. Gloves should be worn as a protection against heat and flying chips
6. Eye and face protection should be used when working with certain tools
7. Hands should be washed after handling tools and before eating

d. Storing tools

1. Tools should be stored properly in order to provide ease and safety in picking up and putting away
2. Heavy tools should be stored near the floor, light tools in higher positions
3. Attempt to store all tools off the floor to avoid dangerous floor space
4. Large tools and heavy tool boxes should be moved by two or more people

THE PLUMBING TRUCK
UNIT V

UNIT OBJECTIVE

After completion of this unit, the student should be able to select equipment kept in the cab, storage bins, and trunk of a plumbing truck. The student should also be able to conduct an inventory of a plumbing truck and perform daily maintenance procedures on an available vehicle. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with the plumbing truck to the correct definitions or descriptions.
2. Distinguish between daily, weekly, monthly, and yearly maintenance procedures associated with the plumbing truck.
3. Name four parts of the plumber's truck where tools, materials, and equipment are stored.
4. Select equipment kept in the cab.
5. Select tools and materials kept in storage bins.
6. Select tools and equipment kept in the truck.
7. List suggestions for organizing the plumber's truck.
8. Conduct an inventory of a plumbing truck.
9. Demonstrate the ability to perform daily maintenance procedures on an available truck.

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THE PLUMBING TRUCK
UNIT V

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information, assignment, and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Demonstrate and discuss the procedures outlined in the job sheets.

   G. Take a field trip or provide for a plumbing contractor to bring a truck to the school shop.

   H. Develop a situation to show the comparison of a well organized truck and a disorganized truck.

   I. Discuss overloading and other abuses to the truck.

   J. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete assignment and job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Maintenance Procedures for Plumbing Trucks

      2. TM 2--Pickup Plumbing Truck

      3. TM 3--Plumbing Truck Cab

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D. Assignment Sheet #1--Conduct an Inventory of a Plumbing Truck

E. Job Sheet #1--Perform Daily Maintenance Procedures on an Available Truck.

F. Test

G. Answers to test

THE PLUMBING TRUCK
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. Plumbing truck--Vehicle which is used to transport workers, tools, equipment, and materials to and from a job site

B. Maintenance--The upkeep of equipment; to keep in an existing state of repair

C. Organization--Keeping tools, equipment, and materials in an orderly fashion to help the worker find the correct item and also to maintain an accurate inventory

D. Responsibility--Being accountable for certain duties, showing trustworthiness and reliability

E. Inventory--The quantity of materials on hand

F. Engine maintenance--Checking oil, water, fan belts, and hydraulic fluid, and adding items when necessary

II. Maintenance procedures (Transparency 1)

A. Daily

1. Conduct routine inspection

   (NOTE: Make sure hood catch, hinge, and spring are in operating condition.)

2. Check oil and add any if needed

   (NOTE: Use a clean cloth or paper, not grass or any dirty material.)

3. Check water and add any if needed

4. Check lights--head, tail, brakes, and direction

   (NOTE: A fellow worker is helpful in this task.)

5. Check brakes for sufficient pedal

   (NOTE: Report any malfunctions of lights or brakes to the employer.)

6. Clean windshield and windows

7. Check air pressure in tires

8. Check gasoline gauge

P-[illegible]1-E

INFORMATION SHEET

B. Weekly

  1. Check tires
  2. Check battery water
  3. Check hydraulic fluid
     a. Transmission
     b. Power steering
     c. Power brakes
  4. Wash complete truck

C. Monthly

  1. Have truck greased

     (NOTE: See manufacturer's specifications.)

  2. Change oil

     (NOTE: See manufacturer's specifications.)

  3. Inspect tires for wear

     (NOTE: Report any malfunction, unusual noise, or excessive wear to your employer.)

  4. Perform major clean-out of truck bed and cab

D. Yearly--Schedule truck for state inspection

   (NOTE: This is not applicable in all states.)

III. Parts of the plumber's truck where materials and equipment are stored (Transparencies 2 and 3)

  A. Cab
  B. Storage bins
  C. Truck bed
  D. Overhead pipe rack

IV. Equipment kept in the cab

  A. A map of the local and surrounding areas
  B. Pencils

INFORMATION SHEET

C. Clipboard for job instructions

D. An ABC fire extinguisher

(NOTE: ABC fire extinguishers can be used on all types of fires.)

E. First aid kit

V. Tools and materials kept in storage bins

A. Small assortment of copper, plastic, and galvanized iron water pipe fittings

(NOTE: Drainage fittings are comparatively expensive and should not be stored on the truck.)

B. Maintenance and repair tools

(NOTE: Some trucks are designated specifically for maintenance and repair, and some trucks specifically for new construction.)

C. Maintenance and repair materials

D. Soldering materials

(NOTE: Soldering materials include flux, solder, sandcloth, pipe hangers, pipe tape, and joint compounds.)

E. Cleaning rags

(NOTE: These should be kept behind the seat.)

VI. Tools and equipment kept in the truck

(NOTE: These are tools that are too large to carry in a tool box.)

A. Pipe wrenches and tongs

B. Small drain cleaners

C. Testing equipment

D. Large hammers

E. Drilling machine

F. Electric saws

G. Pipe vise

(NOTE: Pipe vise is usually mounted on side of truck.)

H. Tri-stand

I. Power vise

H. Torch and propane tank (plus extra tank)

I. Pipe cutters, reamers, and die stock

J. Stepladder

K. Extension cord

L. Drop light

M. Level

N. Tow chain

VII. Suggestions for organizing the plumber's truck

A. Materials and equipment for specific jobs should be loaded on the truck when needed and unloaded when the job is finished

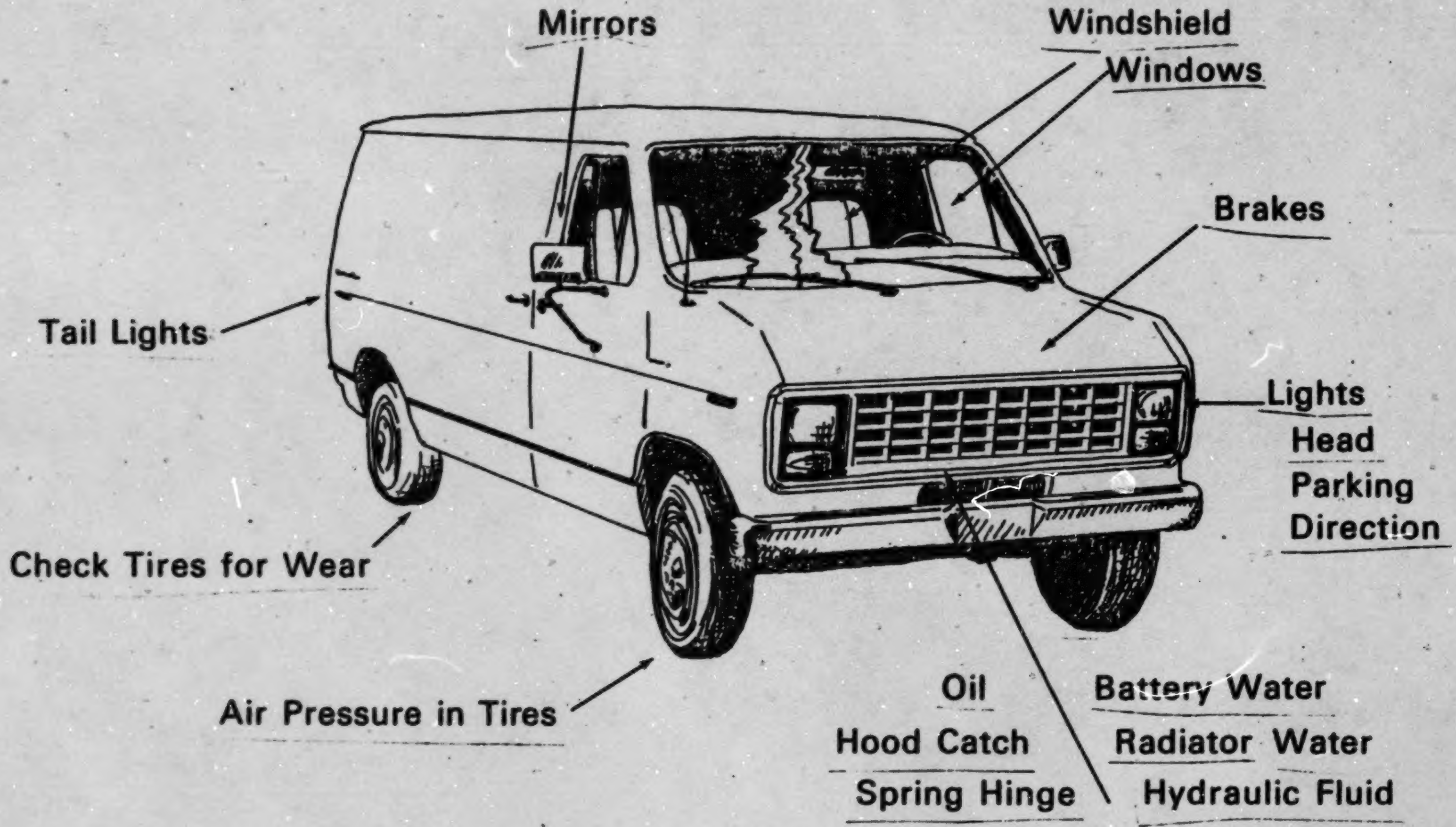
B. An inventory should be made once each month to keep the necessary materials on the truck and to avoid overloading of certain items

(NOTE: Materials are expensive and should not be stored in large quantities for long periods of time.)

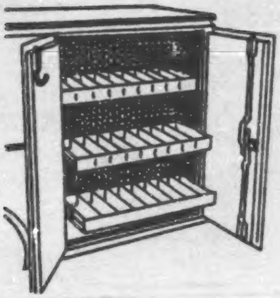
C. The plumber's personal tool box can be stored in the truck

D. The truck should be locked when not attended

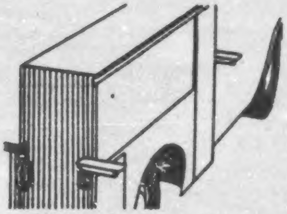
Maintenance Procedures For Plumbing Trucks


Mirrors
Windshield
Windows
Brakes
Tail Lights
Lights
Head
Parking
Direction
Check Tires for Wear
Air Pressure in Tires
Oil
Hood Catch
Spring Hinge
Battery Water
Radiator Water
Hydraulic Fluid

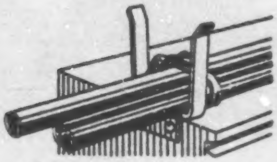
Pickup Plumbing Truck



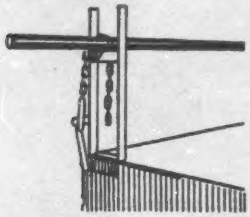
Adjustable shelves with removable dividers. Also available as pull out shelf. Overlap doors for front vertical compartments.



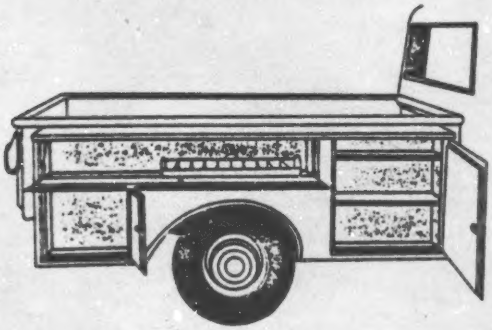
Pipe vise bracket with front support.

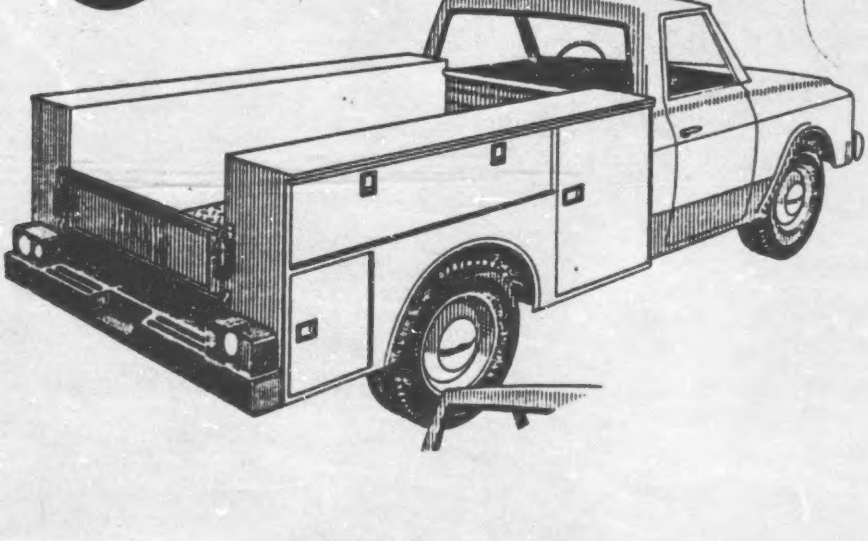


Top mount pipe carrier with strap hold down.

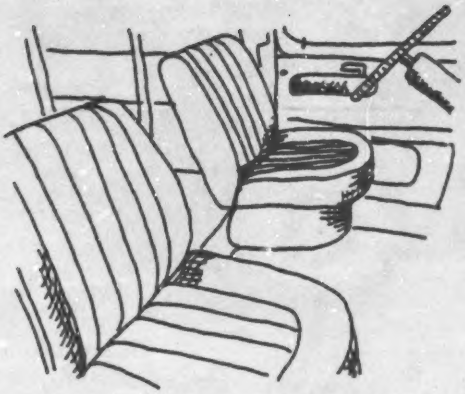


Top mount pipe carrier with spring hold-down.

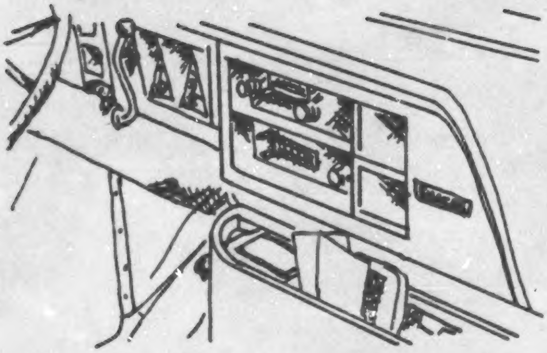




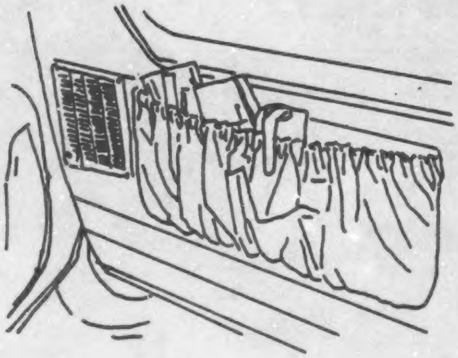
Plumbing Truck Cab



Seats



Dash



Map Pocket

THE PLUMBING TRUCK
UNIT V

ASSIGNMENT SHEET #1--CONDUCT AN INVENTORY OF A PLUMBING TRUCK

EVALUATION: The results of this inventory should correspond with inventory figures derived from receiving and check-out records.

Directions:
Conducting an inventory is a major role of the plumber prior to using the truck each day. Conduct a manual inventory of plumbing tools, equipment, and materials in an available truck. Instructor should provide inventory check sheet.

A. Cab equipment

B. Storage bin tools and materials

C. Truck tools and equipment

THE PLUMBING TRUCK
UNIT V

JOB SHEET #1--PERFORM DAILY MAINTENANCE PROCEDURES ON AN AVAILABLE TRUCK

EVALUATION: Completion of these procedures must be approved by the instructor prior to using the plumbing truck.

I. Tools and materials

   A. Wiping cloth

   B. Oil

   C. Water

II. Procedure

   (NOTE: Plumbers should arrive at work early enough to conduct a routine truck inspection.)

   A. Check the engine hood: catch, hinge, and holding spring

   B. Obtain a wiping cloth

      (NOTE: Do not use grass or any other item except a clean wiping cloth or paper.)

   C. Check the oil level and add any that is needed

   D. Check the water level and add any that is needed

   E. Check brake for sufficient pedal

   F. With the assistance of a fellow worker, check lights

      (NOTE: Check brake lights and direction signals.)

   G. Clean and adjust mirrors

   H. Check air pressure in tires

   I. Check anti-freeze if necessary

   J. Obtain approval of the job from your instructor

THE PLUMBING TRUCK
UNIT V

NAME______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Vehicle which is used to transport workers, tools, equipment, and materials to and from a job site

_____b. The upkeep of equipment; to keep in an existing state of repair

_____c. Keeping tools, equipment, and materials in an orderly fashion to help the worker find the correct item and also to maintain an accurate inventory

_____d. Being accountable for certain duties, showing trustworthiness and reliability

_____e. The quantity of materials on hand

_____f. Checking oil, water, fan belts, and hydraulic fluid and adding items when necessary

1. Inventory
2. Maintenance
3. Engine maintenance
4. Organization
5. Plumbing truck
6. Responsibility

2. Distinguish between daily, weekly, monthly, and yearly maintenance procedures associated with the plumbing truck by placing a "d" next to the daily, a "w" next to the weekly, an "m" next to the monthly, and a "y" next to the yearly maintenance procedures.

_____a. Check hydraulic fluid

_____b. Have truck greased

_____c. Check oil and add any if needed

_____d. Clean windshield and windows

_____e. Check air pressure in tires

_____f. Schedule truck for state inspection

_____g. Change oil

_____h. Check battery water

_____i. Wash complete truck

_____j. Check brakes for sufficient pedal

3. Name four parts of the plumber's truck where tools, equipment, and materials are stored.

   a.

   b.

   c.

   d.

4. Select equipment kept in the cab by placing an "X" in the appropriate blanks.

   ______a. A map of the local and surrounding areas

   ______b. Pencils

   ______c. Fittings

   ______d. Clipboard for job instructions

   ______e. An ABC fire extinguisher

   ______f. Large hammers

   ______g. Cleaning rags

5. Select tools and materials kept in storage bins by placing an "X" in the appropriate blanks.

   ______a. Small assortment of copper, plastic, and galvanized iron water pipe fittings

   ______b. Maintenance and repair tools

   ______c. Maintenance and repair materials

   ______d. Drop light

   ______e. Small drain cleaners

   ______f. Soldering materials

6. Select tools and materials kept in the truck by placing an "X" in the appropriate blanks.

   ______a. Pipe wrenches and tongs

   ______b. Testing equipment

   ______c. Fire extinguishers

   ______d. Electric saws

_____e. Stepladders

_____f. Extra clothing

_____g. Torch and propane tank

_____h. Level

_____i. Pipe cutters, reamers, and die stocks

7. List three suggestions for organizing the plumber's truck.

   a.

   b.

   c.

8. Conduct an inventory of a plumbing truck.

9. Demonstrate the ability to perform daily maintenance procedures on an available truck.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

P-307-E

THE PLUMBING TRUCK
UNIT V

ANSWERS TO TEST

1. a. 5
   b. 2
   c. 4
   d. 6
   e. 1
   f. 3
2. a. w
   b. m
   c. d
   d. d
   e. d
   f. y
   g. m
   h. w
   i. w
   j. d
3. a. Cab
   b. Storage bins
   c. Truck bed
   d. Overhead pipe rack
4. a, b, d, e
5. a, b, c, f
6. a, b, d, e, g, h, i

7. Any three of the following:

   a. Materials and equipment for specific jobs sould be loaded on the truck when needed and unloaded when the job is finished

   b. An inventory should be made once each month to keep the necessary materials on the truck and to avoid overloading of certain items

   c. The plumber's personal tool box can be stored in the truck

   d. The truck should be locked when not attended

8. Evaluated to the satisfaction of the instructor.

9. Performance skills evaluated to the satisfaction of the instructor.

3:0-B

BLUEPRINT READING
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with blueprint reading to the correct definitions and identify the alphabet of lines and drawing symbols. The student should also be able to measure scaled lines, list items included in a set of specifications, and extract specific information from a set of specifications. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with blueprint reading to the correct definitions.
2. Identify five types of architectural drawings.
3. Identify the nine types of lines included in the alphabet of lines.
4. Match the name of floor plan drawing symbols to a picture of the symbol.
5. Identify plumbing, appliance, and structural symbols.
6. Match the name of plumbing blueprint symbols to the correct picture of the symbol.
7. Read an architect's scale.
8. List major items that should be included in a set of specifications.
9. Extract specific information from a prepared set of building specifications.

P-1-C

BLUEPRINT READING
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide students with objective sheet.

   B. Provide students with information and assignment sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Invite an inspector and/or architect to speak to the class.

   G. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete assignment sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1-Plot plan

      2. TM 2--Foundation Plan

      3. TM 3--Floor Plan

      4. TM 4--Elevations

      5. TM 5--Details

P-3-C

    6. TM 6–Alphabet of Lines
    7. TM 7–Alphabet of Lines (Continued)
    8. TM 8–Alphabet of Lines (Continued)
    9. TM 9–Floor Plan Symbols
    10. TM 10–Sectioning Symbols
    11. TM 11–Plumbing Symbols
    12. TM 12–Plumbing Symbols (Continued)
    13. TM 13–The Architect's Scale
    14. TM 14–Comparison of Solid Objects

D. Assignment sheets

    1. Assignment Sheet #1–Read the Architect's Scale at Full Scale or (12" = 1'0")
    2. Assignment Sheet #2–Read the Architect's Scale at Half Scale or (6" = 1'0")
    3. Assignment Sheet #3–Read the Architect's Scale At One-Fourth Scale Or (3" = 1'0")
    4. Assignment Sheet #4–Read the Architect's Scale at One-Eighth Scale or (1 1/2" - 1'0")

E. Answers to assignment sheets

F. Test

G. Answers to test

II. References:

A. D'Arcangelo Bartholomew, Et. Al., *Blueprint Reading For Plumbers*. New York: Delmar, 1973.

B. Dalzell, James R. *Blueprint Reading For Home Builders*. New York: McGraw-Hill, 1955.

C. French, Thomas E. and Charles J. Vierch. *Engineering Drawing*. New York: McGraw-Hill, 1966.

D. Hartman, William J. *Basic Drafting*. Stillwater, Oklahoma: State Department of Vocational and Technical Education, 1972.

E. Helper, Donald E. and Paul I. Wallach. *Architectural Drafting and Design*. New York: McGraw-Hill, 1971.

BLUEPRINT READING
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Alphabet of lines--Set of conventional symbols covering all the lines needed to depict an object as to size and shape

B. Architect's scale--A rule divided into proportional feet and inches; a fraction of an inch is proportionally equal to one foot

Examples: 1/8, 1/4, 3/8, 1/2, 3/4, 1 1/2, and 3 inches to the foot

C. Architectural drawings--Step by step directions which are shown in picture form

(NOTE: They are sometimes called construction drawings.)

D. Blueprint--A copy of the original detailed drawing

E. Building code--Collection of laws listed in booklet form that apply to a given community, state or nation

F. Detail view--A drawing that gives complete detailed information for the construction of a single part

G. Dimensions--The arrangement of lines and symbols to indicate the actual size for constructing the object that is represented

H. Elevation view--Drawings representing the front, sides or rear face of a building and usually made as though the observer were looking straight at it

I. Plan view--Horizontal cut through a building showing the foundation, rooms, partitions, windows, doors, and stairs

J. Scale drawing--A drawing made to size either proportionally larger or smaller than the actual size of the object represented

K. Section view--A drawing of an object that has been cut to show internal construction

L. Specifications--A detailed set of written instructions which explains the drawing and becomes part of the contract

M. Symbol--An arbitrary sign that has been standardized and is used to represent an object, quality, or method

N. Working drawing--A technical drawing which includes all dimensions and procedures to guide workers in the construction of a building

O. Roof Pitch--Angle of roof designed to drain rain water and also adds to beauty of the building

P-5-C

INFORMATION SHEET

II. Types of architectural drawings (Transparencies 1, 2, 3, 4, and 5)

  A. Plot plan–Characteristics include:

  (NOTE: The entrance to the building should be located at the bottom of the page.)

    1. The location of the building on the lot

    (NOTE: The plot plan sometimes shows legal descriptions of the building.)

    2. Finished grade contours
    3. Property lines
    4. Available utilities
    5. Location of existing trees
    6. Sewer pipe extension location from house

  B. Foundation plan–Characteristics include:

  (NOTE: The entrance to the building should be located at the bottom of the page.)

    1. The location of footings, stemwalls, and piers
    2. Openings and clearance for crawl space under a conventional wood floor
    3. Entrance for underground utilities and services

  C. Floor plan–Characteristics include:

  (NOTE: The entrance to the building should be located at the bottom of the page on the plan.)

    1. Outside walls including the location and dimensions of all exterior openings
    2. The type of construction through the use of symbols
    3. The location of interior walls and partitions
    4. The way a door is to swing
    5. Stairways
    6. The location of cabinets and built-ins and plumbing fixtures

INFORMATION SHEET

D. Elevation

1. Characteristics
    - a. Grade line
    - b. Floor heights
    - c. Head and sill heights of windows in each story
    - d. Roof line and pitch
    - e. Cornice
2. Typical elevations
    - a. Front
    - b. Left
    - c. Right
    - d. Rear
    - e. Sectional (optional)

E. Details--Characteristics include:

(NOTE: These drawings are primarily used to depict details of construction that are too small or not clearly shown on the plan or elevation drawings. They may be full size or to a larger scale than the plan elevation, or a sectional view.)

1. Molding
2. Mill work
3. Ornamental iron
4. Cabinets
5. Built-ins
6. Fireplace
7. Stairs

    (NOTE: Sections are used freely on these drawings.)

8. Mechanical drawing--Plumbing and heating

    (NOTE: This is only occasionally shown on residential blueprints.)

INFORMATION SHEET

III. Alphabet of lines (Transparencies 6, 7, and 8)

A. Object lines (————————————)--Show the main outline of the building including exterior walls, interior partitions, porches, patios, driveways, and interior walls; these lines should be outstanding lines on a drawing

B. Dimension lines(◄————————————►)--Thin unbroken lines which building dimensions are placed upon

C. Extension lines (————————————)--Extend, but do not touch, the object lines and permit dimension lines to be drawn between them

D. Hidden lines (— — — — — — — — — — —)--Short dashes used to show lines that are not visible from that view

E. Center lines (——— — ——— — ———)--A series of short and long dashes used to designate the center of doors, windows, and circles and to provide a reference point for dimensioning

F. Cutting-plane lines (▲—— - - ——— - - —▲)--Heavy lines consisting of a series of one long and two short dashes with arrows at each end pointing away from the area that is cut away for the purpose of sectioning

G. Section lines (////—)--A series of lines of various shape or symbols used to depict an area that is a cross section of the whole object and also depicts the type of material to be used in construction

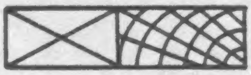
H. Break lines (——∿————∿——)--Used when an area cannot or should not be drawn entirely

I. Leaders (◄————————)--Used to connect a note or dimension to a part of the building

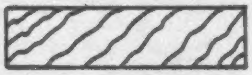
IV. Symbols

A. Floor plan (Transparencies 9 and 10)

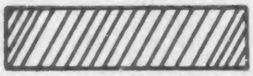
1. Wood (rough)



2. Wood (finished)

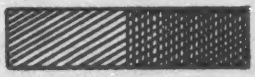


3. Brick

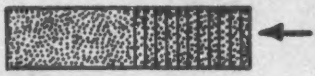


INFORMATION SHEET

4. Firebrick

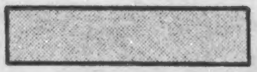


5. Concrete

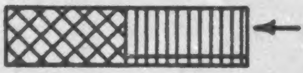


Conc Block

6. Sand, plaster, cement, gypsum board

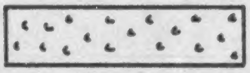


7. Tile-hollow, Terra-cotta

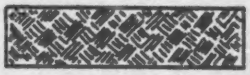


Glazed

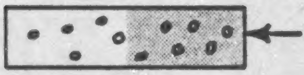
8. Cinders



9. Earth

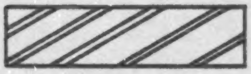


10. Gravel

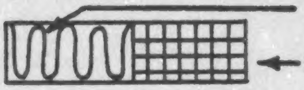


With Sand

11. Structural steel or iron



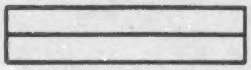
12. Insulation



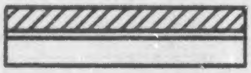
Loose

Solid

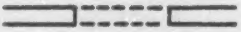
13. Flashing, termite barrier, waterproofing



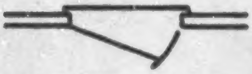
14. Brick veneer

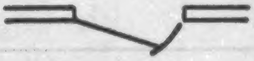


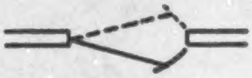
15. Arch–Cased opening

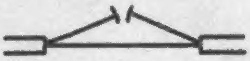


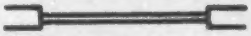
INFORMATION SHEET

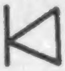
16. Outside door 

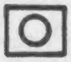
17. Inside door 

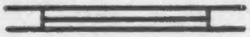
18. Double-acting door 

19. Casement window 

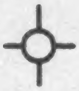
20. Double-hung window 

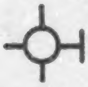
21. Telephone jack 

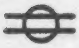
22. Floor drain 

23. Glass 

B. Electrical

1. Ceiling outlet 

2. Wall bracket outlet 

3. Duplex outlet 

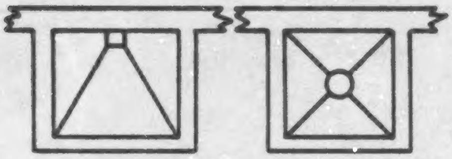
4. Switch (single pole) S_1

5. Switch (3 way) S_3

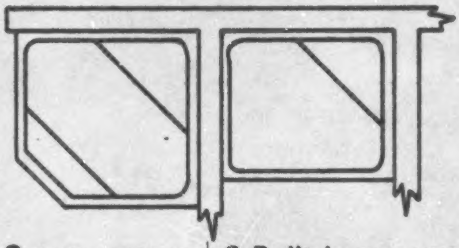
INFORMATION SHEET

V. Plumbing, appliance, and structural symbols (Transparencies 11 and 12)

A. Plumbing

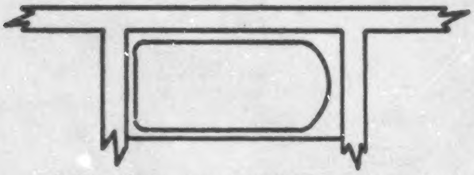


1.Showers

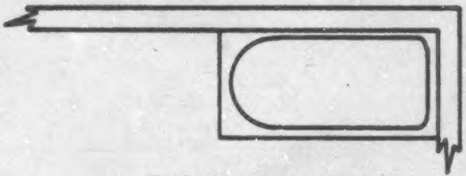


2.Square corner bathtub

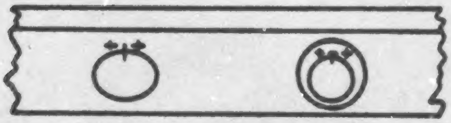
3.Built-in square bathtub



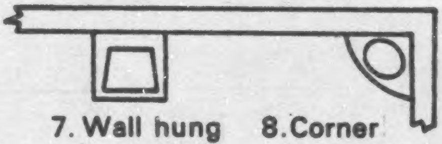
4.Built-in bathtub(Recessed)



5.Corner bathtub

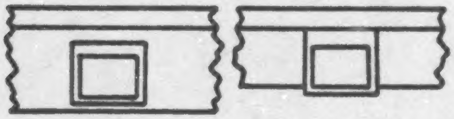


6.Built-in lavatories

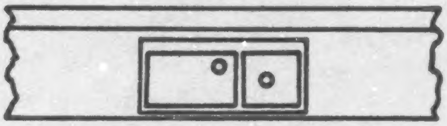


7. Wall hung lavatory

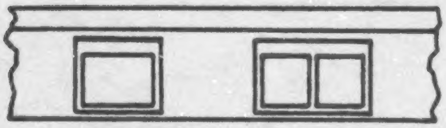
8.Corner lavatory



9.Built-in lavatories

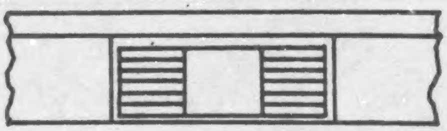


10.Shallow bowl sink



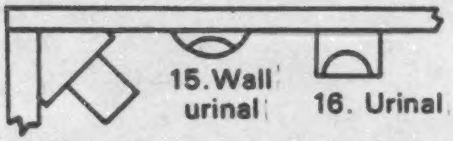
11.Single bowl sink

12.Double bowl sink



13.Double drainboard sink with cabinet

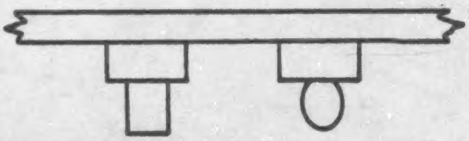
INFORMATION SHEET



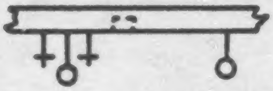
14.Corner water closet

15.Wall urinal

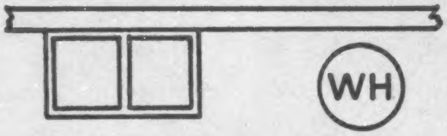
16. Urinal



17.Toilet stools or water closets



18.Shower heads

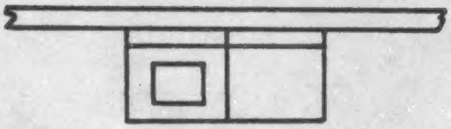


19.Laundry tubs

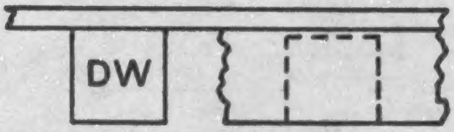
20.Water heater (designate capacity and fuel)

INFORMATION SHEET

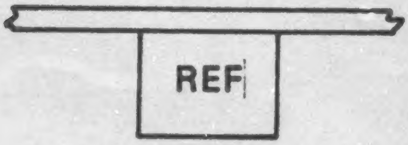
B. Appliances



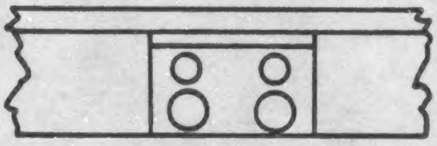
1.Washer and dryer



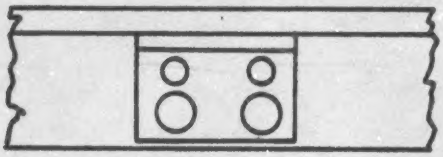
2.Freestanding and built-in dishwashers



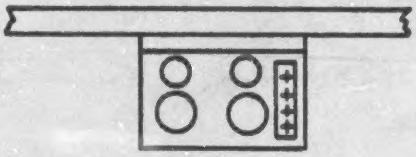
3.Refrigerator or freezer



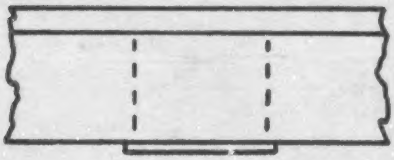
4.Freestanding range



5.Drop-in range



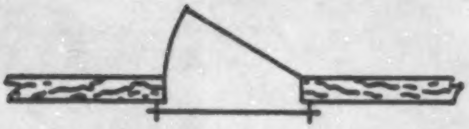
6.Surface cook top



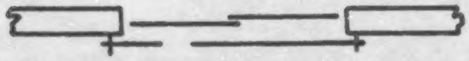
7.Built-in oven

INFORMATION SHEET

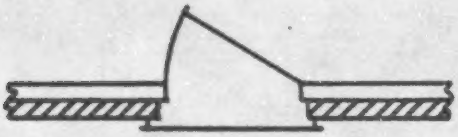
C. Structural symbols



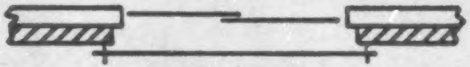
1.Plan view of exterior door in wood frame wall



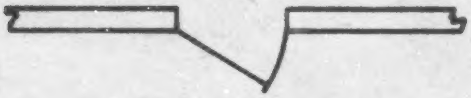
2.Plan view of exterior sliding door in wood frame wall



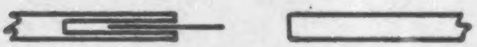
3.Plan view of exterior door in masonry veneer wall



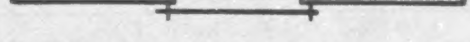
4.Plan view of exterior sliding door in masonry veneer wall



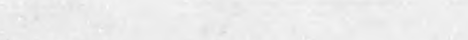
5.Plan view of interior hinged door



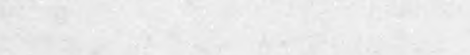
6.Plan view of interior pocket door



7.Single window in frame wall



8.Multiple windows in frame wall



9.Plan view of double hung window in frame wall

INFORMATION SHEET

VI. Plumbing blueprint symbols

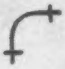
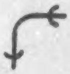
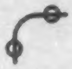
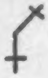
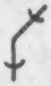
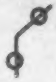
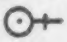
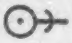
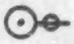
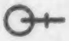
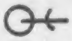
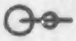
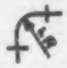
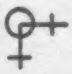
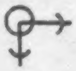
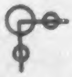
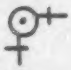
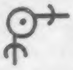
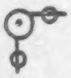
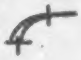
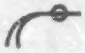
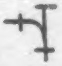
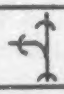
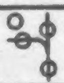
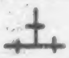
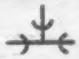
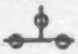
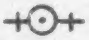
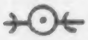
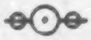
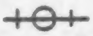
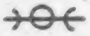
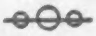
Piping Symbols For Plumbing

A.	————————	Drain or Waste Above Ground
B.	—— —— ——	Drain or Waste Below Ground
C.	— — — — —	Vent
D.	——— SD ———	Storm Drain
E.	—— – ——— – –	Cold Water
F.	——— SW ———	Soft Cold Water
G.	—— - - ——— - - -	Hot Water
H.	——— S ———	Sprinkler Main
I.	—○———○—	Sprinkler Branch and Head
J.	——G—G——	Gas
K.	——— A ———	Compressed Air
L.	——— V ———	Vacuum
M.	S-CI ————————	Sewer - Cast Iron
N.	S-CT ————————	Sewer - Clay Tile
O.	S-P ————————	Sewer - Plastic

Piping Symbols For Heating

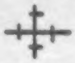
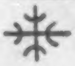
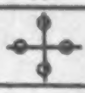
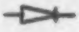
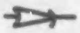
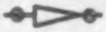
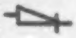
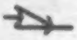
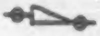
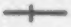
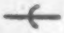
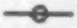
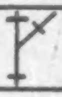
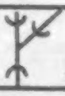
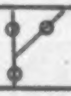
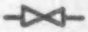
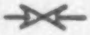
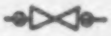
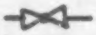
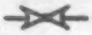
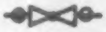
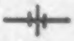
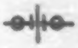
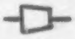
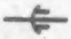
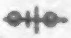
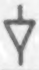
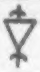
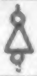
P.	—//———//—	High-Pressure Steam
Q.	—/——/——/—	Medium-Pressure Steam
R.	————————	Low Pressure Steam
S.	——— FOS ———	Fuel Oil Supply
T.	——— HW ———	Hot Water Heating Supply
U.	——— HWR ———	Hot Water Heating Return

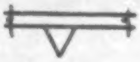
INFORMATION SHEET

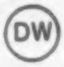
Fittings or Valves Symbols			
Fitting Or Valve	Type Of Connection		
	Screwed	Bell And Spigot	Soldered Or Cemented
V. Elbow - 90 Deg.			
W. Elbow- 45 Deg.			
X. Elbow- Turned Up			
Y. Elbow - Turned Down			
Z. Elbow - Long Radius			
AA. Elbow With Side Inlet - Outlet Down			
BB. Elbow With Side Inlet - Outlet Up			
CC. Reducing Elbow			
DD. Sanitary T			
EE. T			
FF. T - Outlet Up			
GG. T - Outlet Down			

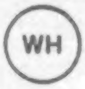
16-C

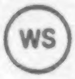
INFORMATION SHEET

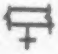
Fitting Or Valve	Type Of Connection Screwed	 Bell And Spigot	 Soldered Or Cemented
HH. Cross			
II. Reducer - Concentric			
JJ. Reducer Offset (Eccentric)			
KK. Connector			
LL. Y Or WYE			
MM. Valve - Gate			
NN. Valve - Globe			
OO. Union			
PP. Bushing			
QQ. Increaser			

RR. Vacuum Outlet 

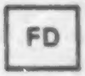
SS. Dry Well 

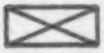
TT. Water Heater 

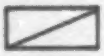
UU. Water Softener 

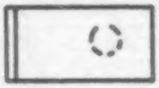
VV. Hose Bib 

INFORMATION SHEET

WW. Floor Drain 

XX. Supply Air Duct 

YY. Return Air Duct 

ZZ. Heating Unit 

VII. The architect's scale (Transparencies 13 and 14)

A. Rules for reading a scale

1. Select proper scale ratio
2. Scale should lay flat on the surface being measured
3. Double check all measurements
4. Practice measuring from the center of one line to the center of the next line
5. Do not use a scale where dimensions are available

B. Common scales to which plans are drawn

1. 12" = 1'-0" (full scale)
2. 6" = 1' - 0" (one-half scale)
3. 3" = 1' - 0" (one-fourth scale)
4. 1/2" = 1' - 0"
5. 1/4" = 1' - 0"
6. 1/8" = 1' - 0"

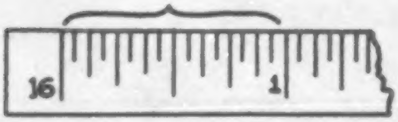
INFORMATION SHEET

C. Interpreting graduations on the architect's scale

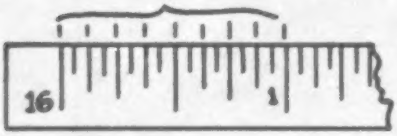
(NOTE: Some scales read from right to left and vice versa.)

1. The sixteenth scale

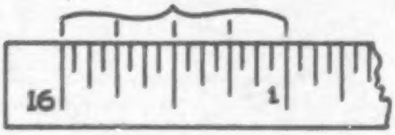
a. 16 - 16ths make one inch



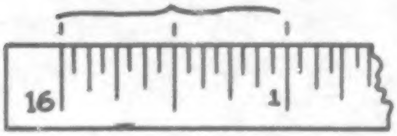
b. 8 - 8ths make one inch; 2 - 1/16" make 1/8"



c. 4 - 4ths make one inch; 4 - 1/16" make 1/4"



d. 2 - 1/2"s make one inch; 8 - 1/16"s make one inch



e. Dimensions are read in this order

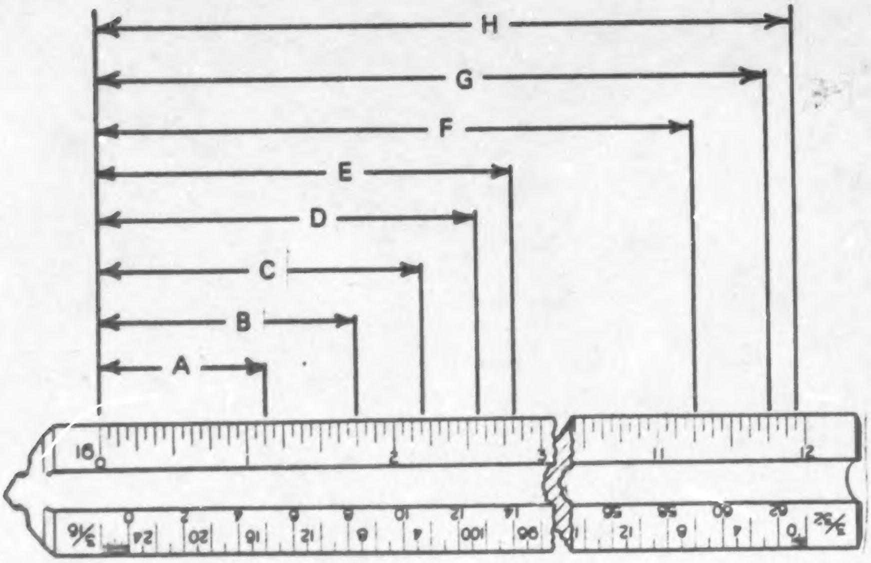
1) Feet marked thus (')

2) Inches marked thus (")

3) Fractions of an inch

INFORMATION SHEET

f. Practice reading the following dimensions in inches and 1/16" (full scale)



1) A = 1" + 2/16" = 1 2/16" or 1 1/8"

2) B = 1" + 12/16" = 1 12/16" or 1 3/4"

3) C = 2" + 3/16" = 2 3/16"

4) D = 2" + 9/16" = 2 9/16"

5) E = 2" + 13/16" = 2 13/16"

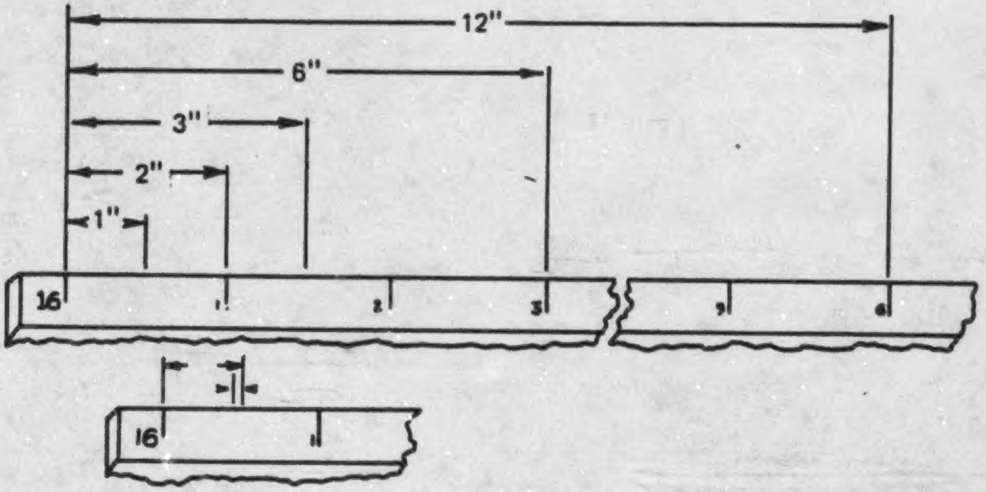
6) F = 11" + 4/16" = 11 4/16" or 11 1/4"

7) G = 11" + 12/16" = 11 12/16" or 11 3/4"

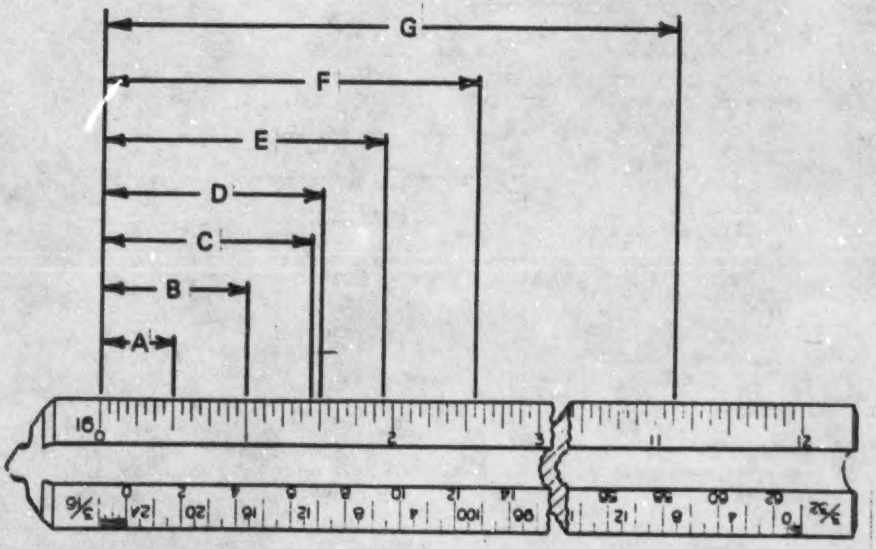
8) H = 11" + 15/16" = 11 15/16"

INFORMATION SHEET

g. One-half scale or 6" represents 12"


12"
6"
3"
2"
1"
16
1
2
3
16

At half scale the 1/16" graduations each represent 1/8"


G
F
E
D
C
B
A
16
0
2
3
11
12

INFORMATION SHEET

1) A = 8/8ths = 1"

2) B = 16/8ths = 2"

3) C = 2" + 6/8ths = 2 6/8" or 2 3/4"

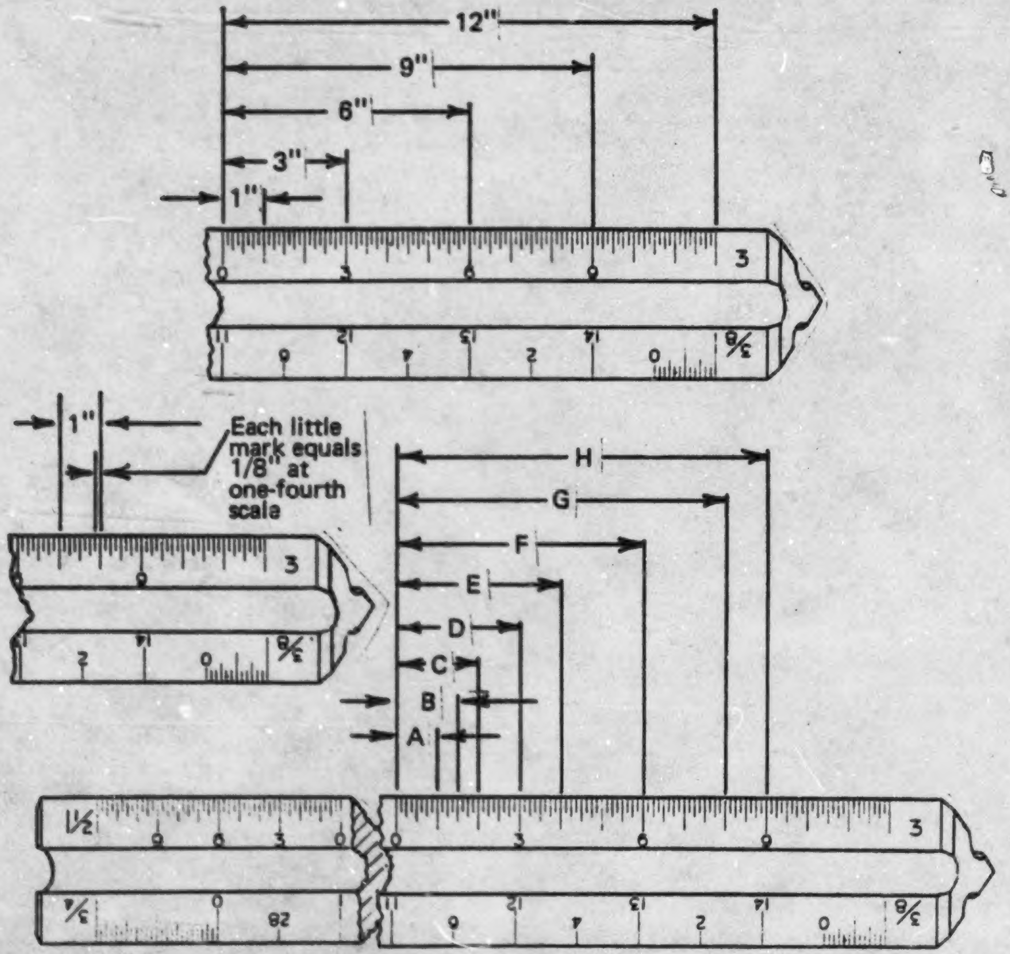
4) D = 2" + 7/8ths = 2 7/8"

5) E = 3" + 7/8ths = 3 7/8"

6) F = 5" + 1/8ths = 5 1/8"

7) G = 22" + 2/8ths = 22 2/8" or 22 1/4"

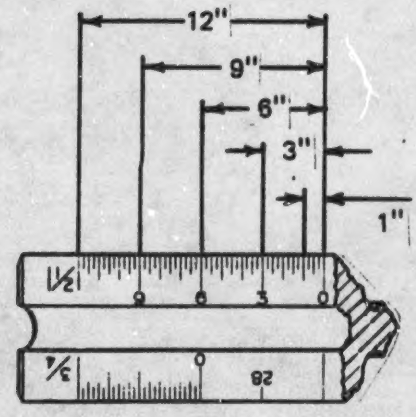
h. One-fourth scale or 3" = 12"

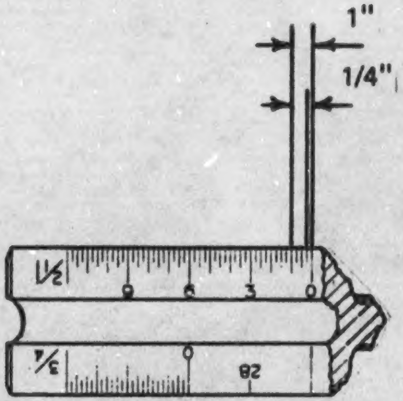

12"
9"
6"
3"
1"
0
3
6
9
3
11
12
13
14
3/8
1"
Each little mark equals 1/8" at one-fourth scale
H
G
F
E
D
C
B
A
1½
0
3
6
9
28
3/4

INFORMATION SHEET

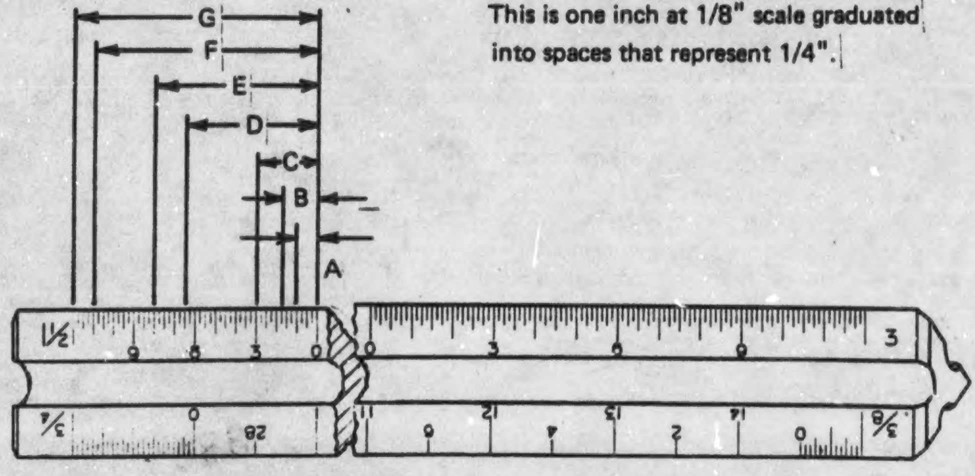
1) A = 8 graduations = 1"
2) B = 1" + 4/8" = 1 4/8 or 1 1/2"
3) C = 1" + 8/8" = 1 8/8" or 2"
4) D = The number 3 = 3"
5) E = 3" + 6/8 = 3 6/8" or 3 3/4"
6) F = The number 6 indicates = 6"
7) G = 8 + 2/8" = 8 2/8" or 8 1/4"
8) H = The number 9 indicates = 9"

i. Reading the one-eighth scale or 1 1/2" represents 12"


12"
9"
6"
3"
1"
1½
9
6
3
0
3/4
0
28


1"
1/4"
1½
9
6
3
0
3/4
0
28

This is one inch at 1/8" scale graduated into spaces that represent 1/4".


G
F
E
D
C
B
A
1½
9
6
3
0
0
3
6
9
3
3/4
0
28
11
9
12
4
13
2
14
0
3/8

INFORMATION SHEET

1) A = 4 graduations = 1"

2) B = 1" + 3/4" = 1 3/4"

3) C = The number 3 represents 3"

4) D = 6" + 2/4" = 6 2/4" or 6 1/2"

5) E = 8 + 1/4" = 8 1/4"

6) F = 2" past 9 represents 11"

7) G = 1 1/2" represents 12"

VIII. Items included in a set of specifications

A. Sizes

B. Types and quality of building materials

C. Methods of construction

D. Types of material

E. Owner's name and address

F. Contractor's name and address

G. Location of new structure

H. Completion date

I. Contractor's bid

J. Guarantees

K. Method of payment

L. Manner of workmanship

M. Wages to be paid

(NOTE: Wages to be paid are not always included on specifications.)

INFORMATION SHEET

IX. Specifications

(NOTE: This is an example of a detailed specification statement for the plumbing contractor on a small residence)

Plumbing

This contractor shall install a complete plumbing system as per these plans and specifications.

All water piping shall be copper type "L"

All above ground drainage and vent piping shall be copper DWV

Underground drainage pipe shall be cast iron

All plumbing must adhere to the local plumbing code

Building drain must be connected to city sewer lateral at curb

Service pipe must be copper type "K" and connected at curb and meter

All fixtures must be provided with air chambers on their water distribution pipes

Outside sillcocks must be 12" freeze-proof type

Fixtures:

Kitchen Sink--Acme "Master Chef" #7940 - Avocado

Bath--Acme "Salt Wara" #8016-Blue

Lavatory--Acme "Hanwas" #122 - Blue

Water Closet--Acme "Wasam" #16 - Blue

Sink fitting--Groget "Klin" #8786

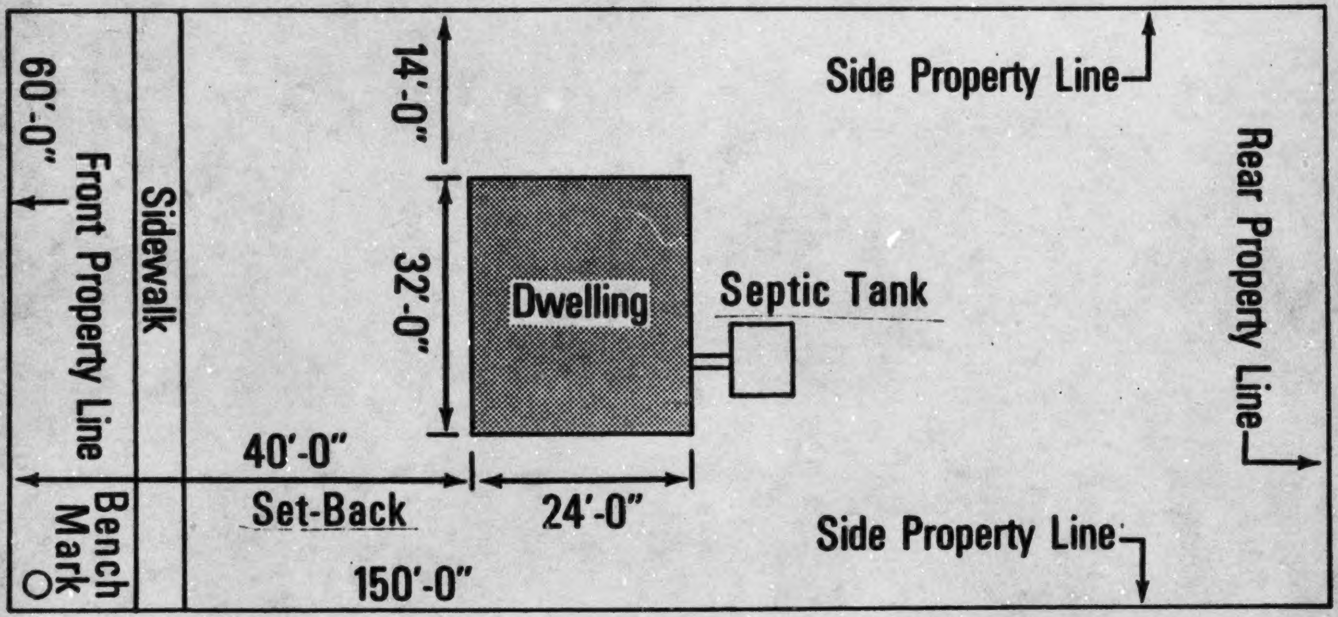
Lavatory fitting--Groget "Nogot" #88

Bath-Shower fitting--Groget "Long Wara" #32 124

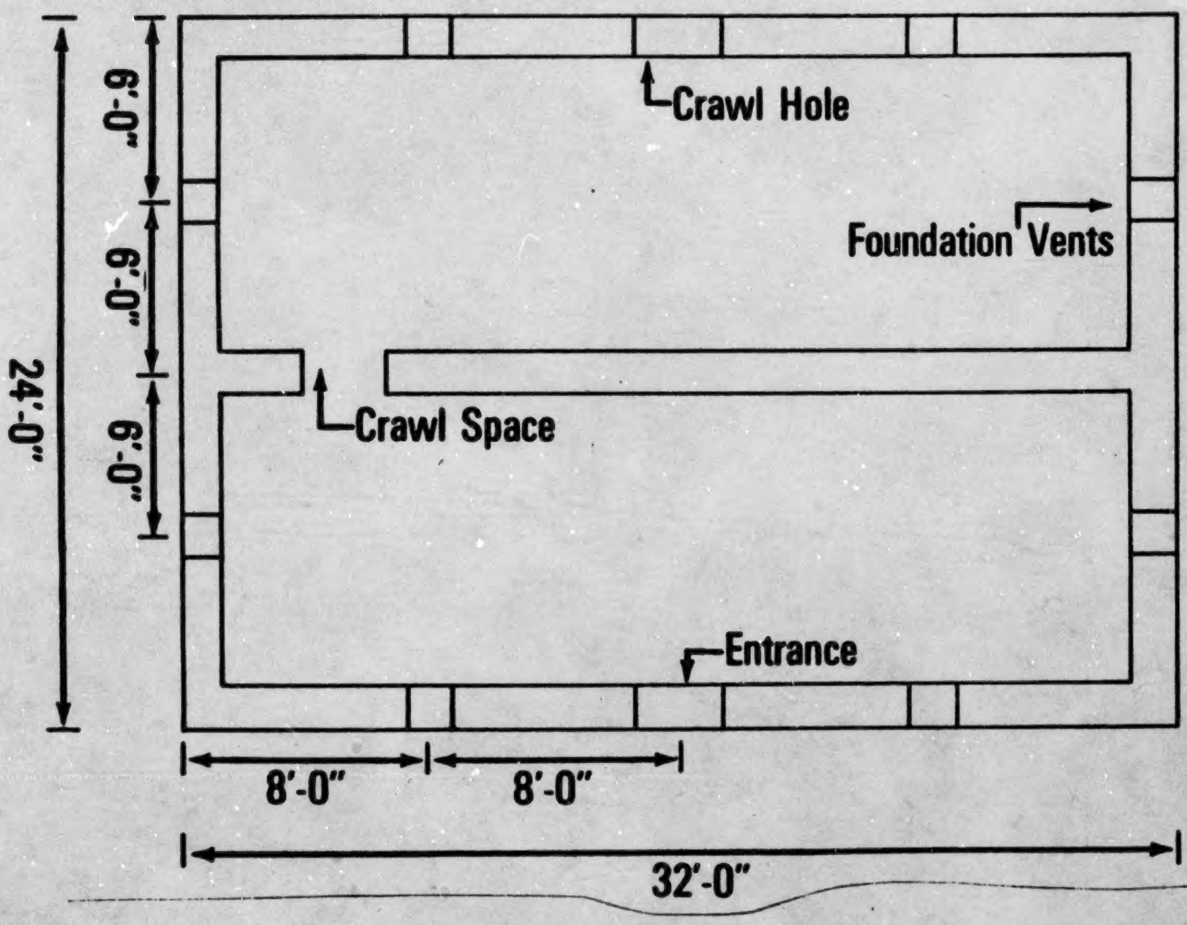
The owner reserves the right to make changes by negotiating the contract.

P-25-C

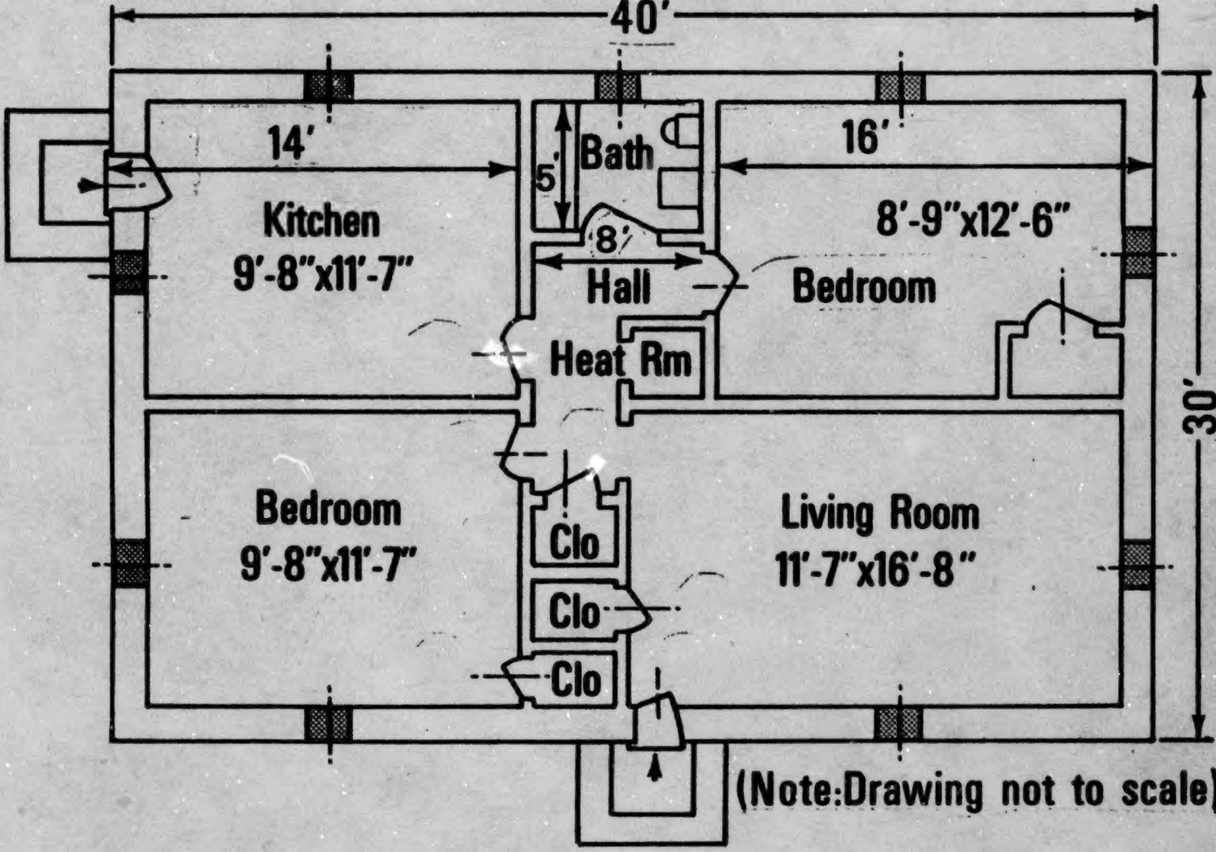
Plot Plan


60'-0"
Front Property Line
Sidewalk
14'-0"
32'-0"
Dwelling
Septic Tank
Side Property Line
Rear Property Line
40'-0"
Set-Back
24'-0"
Side Property Line
Bench Mark
150'-0"

Foundation Plan

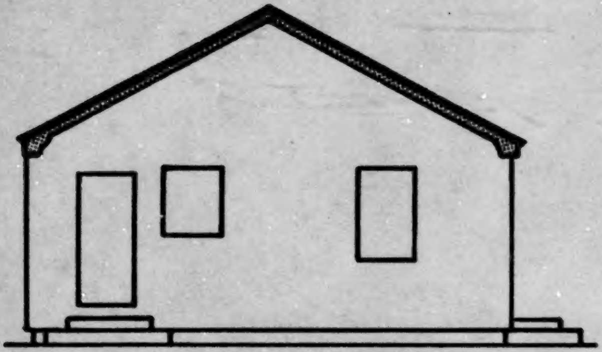

6'-0"
6'-0"
6'-0"
24'-0"
Crawl Hole
Foundation Vents
Crawl Space
Entrance
8'-0"
8'-0"
32'-0"

Floor Plan

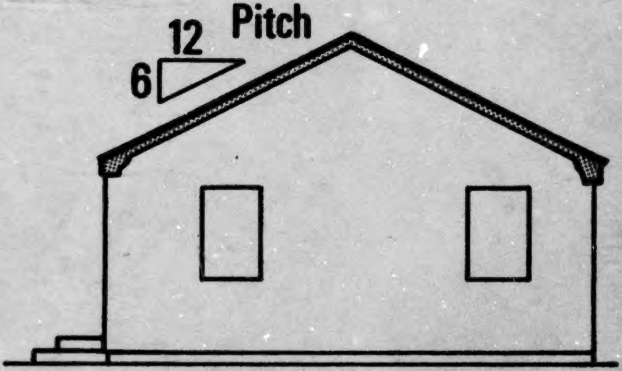

40′
14′
Bath
5′
16′
Kitchen
9′-8″x11′-7″
8′
Hall
8′-9″x12′-6″
Bedroom
Heat Rm
30′
Bedroom
9′-8″x11′-7″
Clo
Clo
Clo
Living Room
11′-7″x16′-8″

(Note:Drawing not to scale)

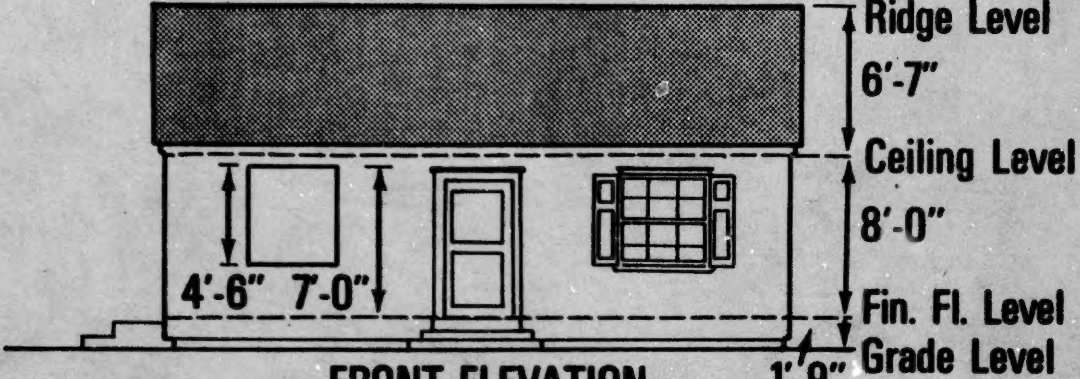
Elevations



LEFT SIDE ELEVATION



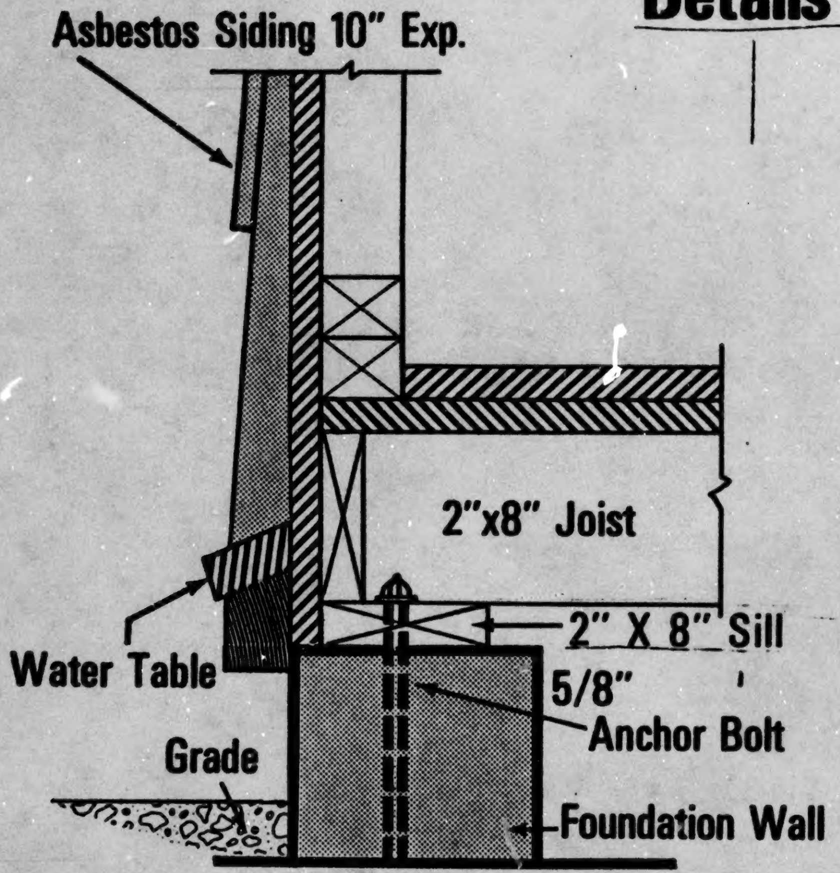
RIGHT SIDE ELEVATION


Ridge Level
6'-7"
Ceiling Level
8'-0"
Fin. Fl. Level
Grade Level
4'-6"
7'-0"
1'-9"

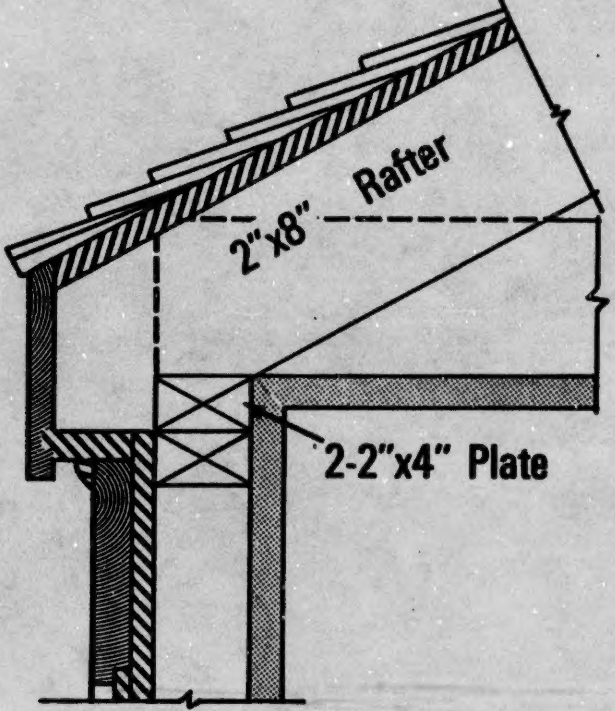
FRONT ELEVATION

Scale 1/8"=1'-0"

Details

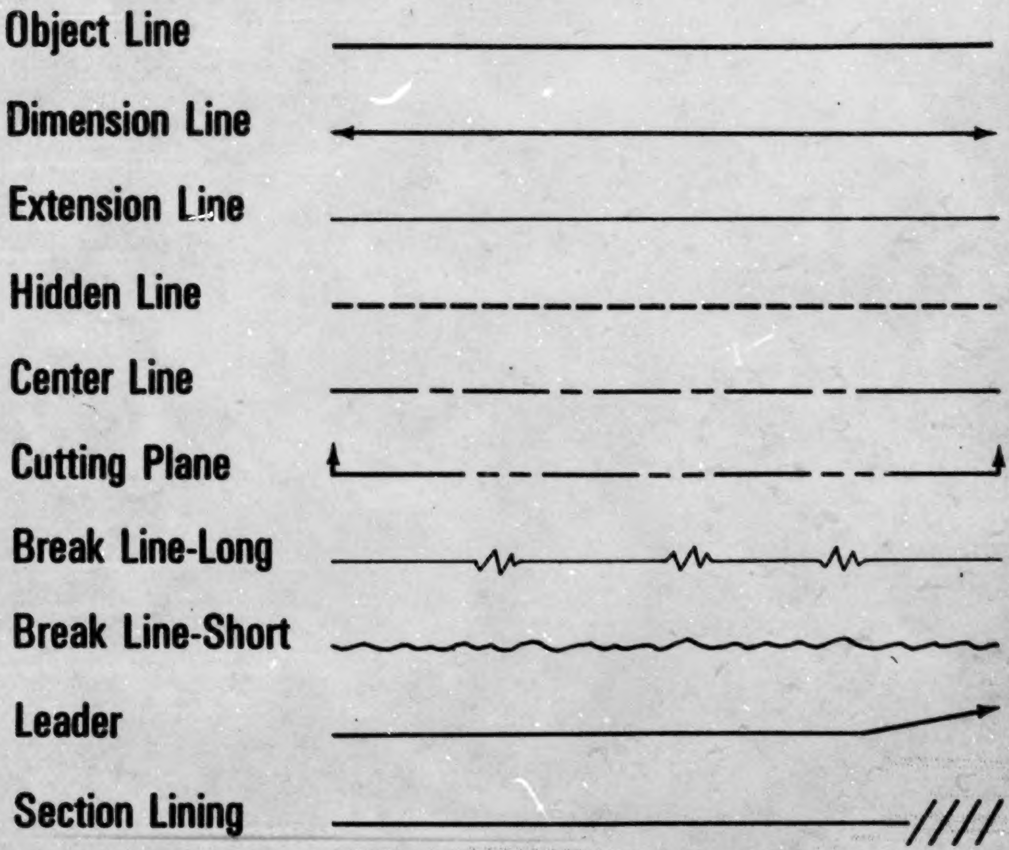

Asbestos Siding 10" Exp.
2"x8" Joist
2" X 8" Sill
5/8"
Anchor Bolt
Water Table
Grade
Foundation Wall

SECTION THRU SILL


Rafter
2"x8"
2-2"x4" Plate

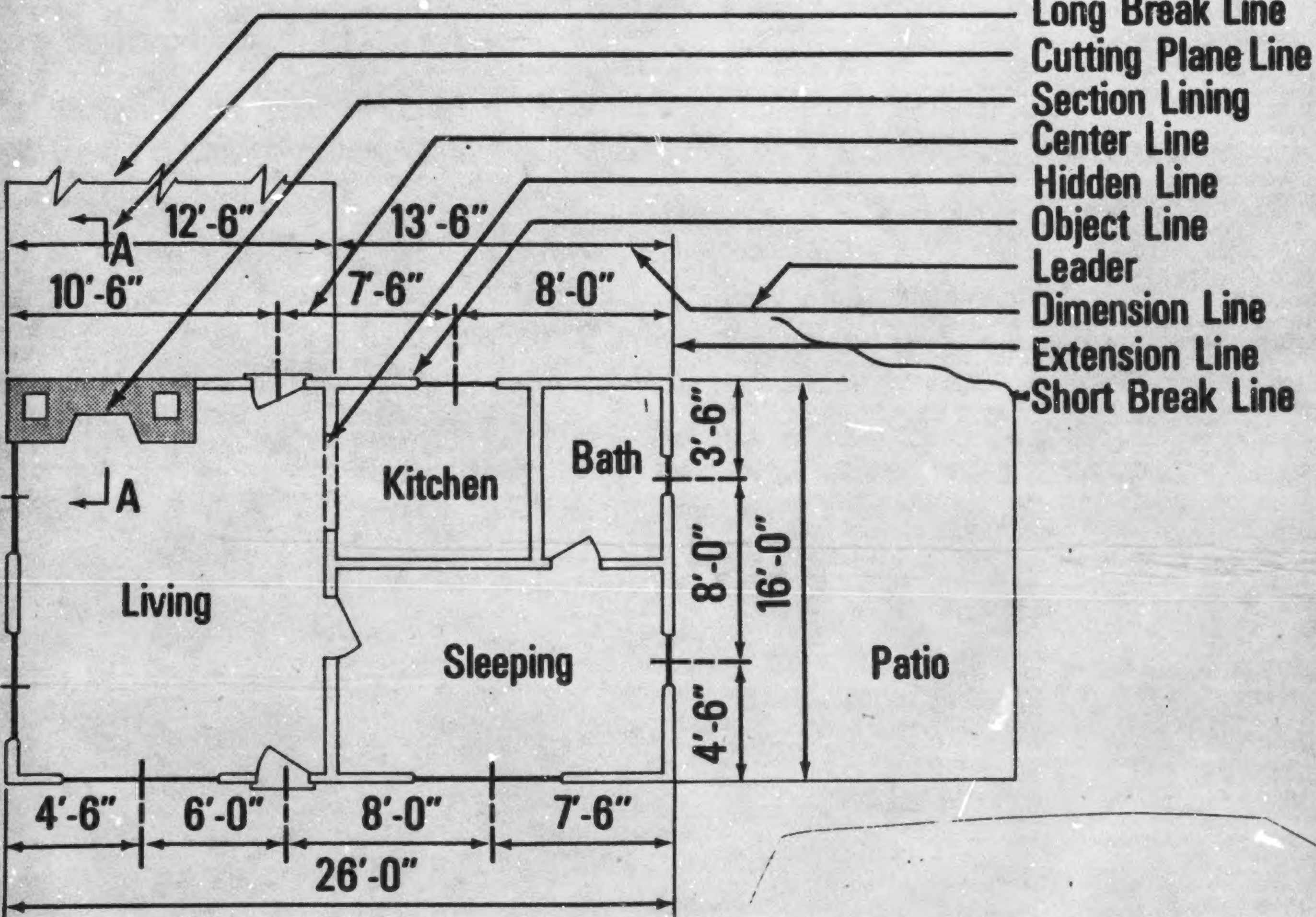
SECTION THRU CORNICE

Alphabet of Lines


Object Line
Dimension Line
Extension Line
Hidden Line
Center Line
Cutting Plane
Break Line-Long
Break Line-Short
Leader
Section Lining

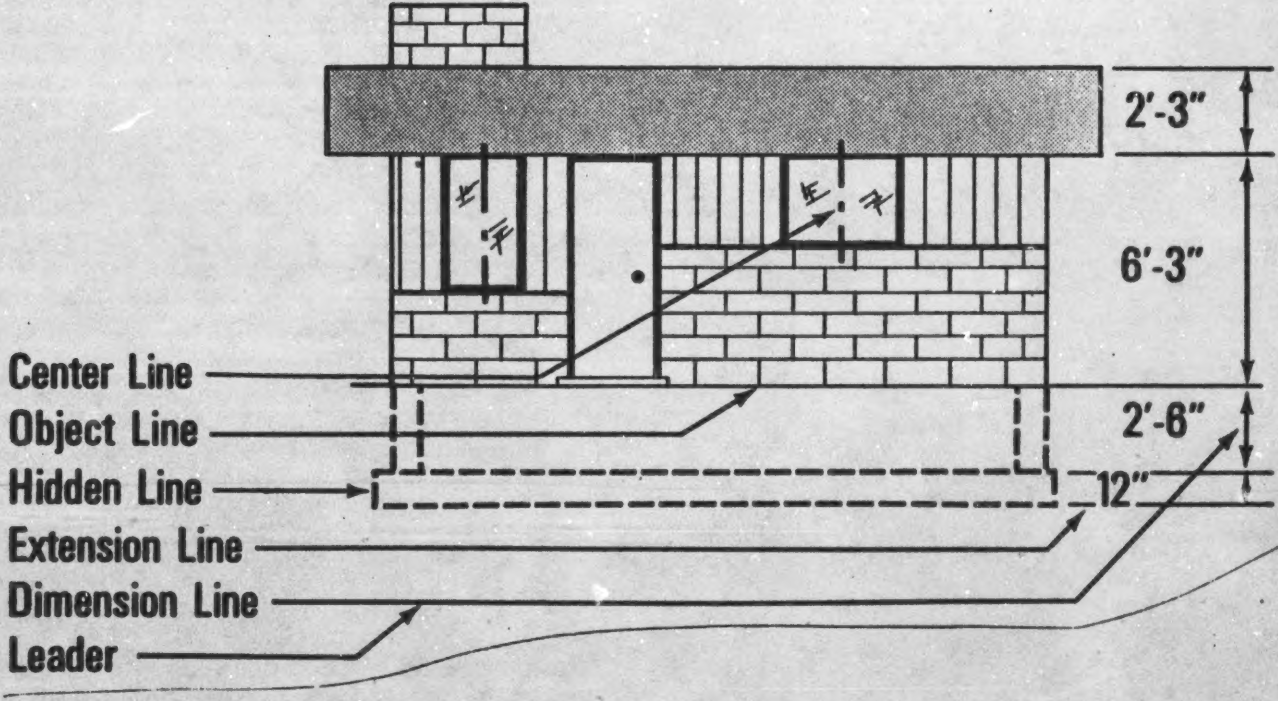
Alphabet of Lines

(Continued)

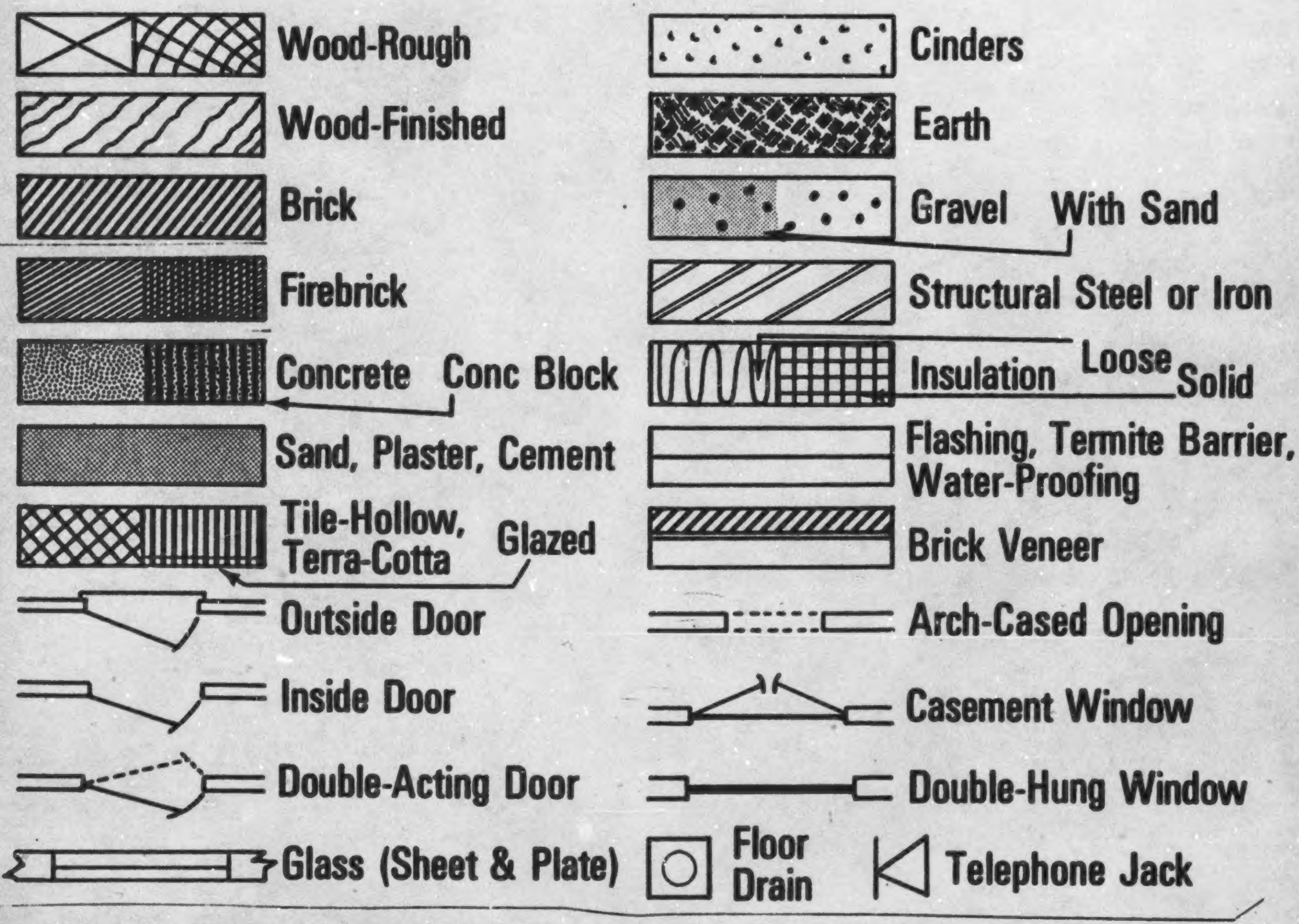

Long Break Line
Cutting Plane Line
Section Lining
Center Line
Hidden Line
Object Line
Leader
Dimension Line
Extension Line
Short Break Line
A
12'-6"
13'-6"
10'-6"
7'-6"
8'-0"
A
Kitchen
Bath
Living
Sleeping
Patio
3'-6"
8'-0"
16'-0"
4'-6"
4'-6"
6'-0"
8'-0"
7'-6"
26'-0"

Alphabet of Lines

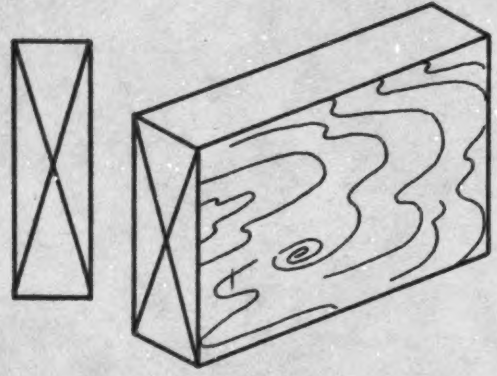
(Continued)


2'-3"
6'-3"
2'-6"
12"
Center Line
Object Line
Hidden Line
Extension Line
Dimension Line
Leader

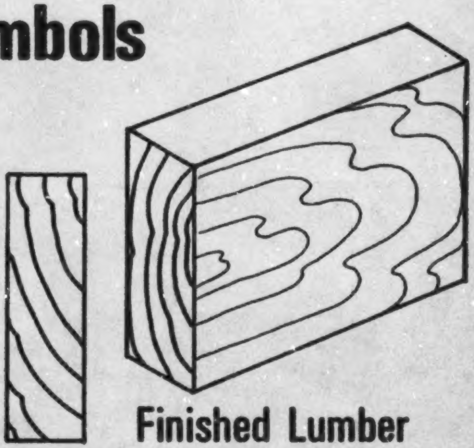
Floor Plan Symbols


Wood-Rough
Cinders
Wood-Finished
Earth
Brick
Gravel
With Sand
Firebrick
Structural Steel or Iron
Concrete
Conc Block
Insulation
Loose
Solid
Sand, Plaster, Cement
Flashing, Termite Barrier, Water-Proofing
Tile-Hollow, Terra-Cotta
Glazed
Brick Veneer
Outside Door
Arch-Cased Opening
Inside Door
Casement Window
Double-Acting Door
Double-Hung Window
Glass (Sheet & Plate)
Floor Drain
Telephone Jack

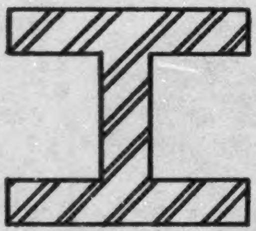
Sectioning Symbols



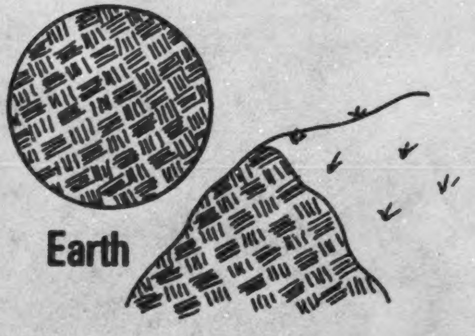
Rough Lumber



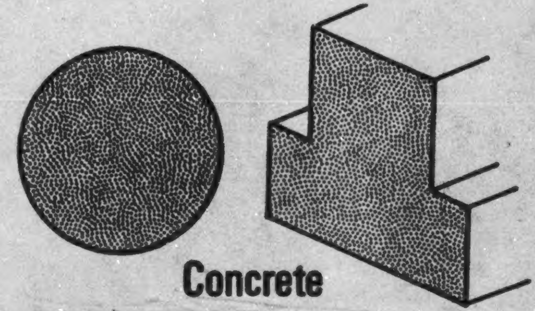
Finished Lumber



Metal

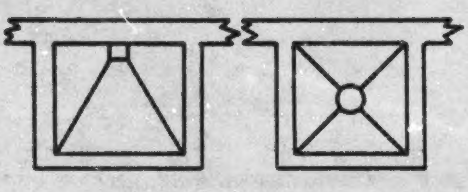


Earth

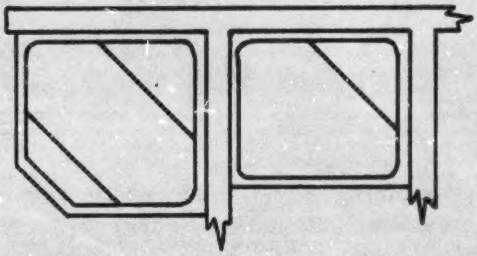


Concrete

Plumbing Symbols

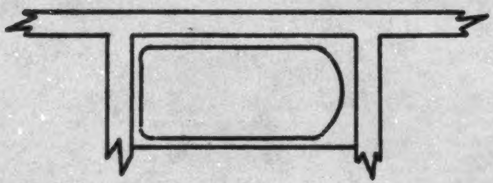


Showers

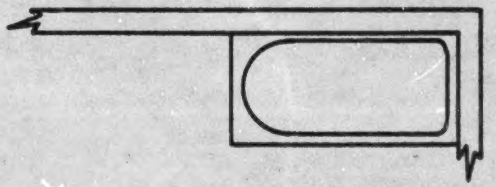


Square corner bathtub

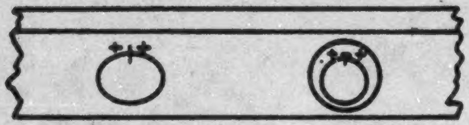
Built-in square bathtub



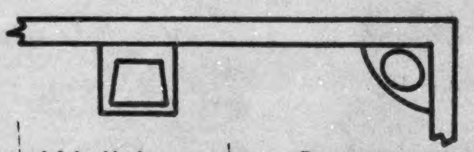
Built-in bathtub (Recessed)



Corner bathtub

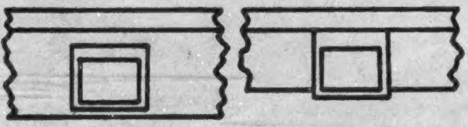


Built-in lavatories

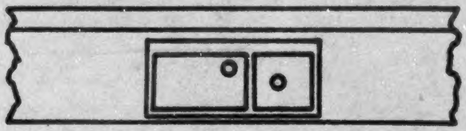


Wall hung lavatory

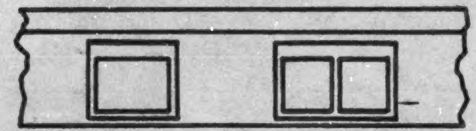
Corner lavatory



Built-in lavatories

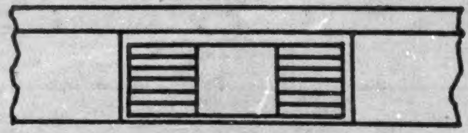


Shallow bowl sink

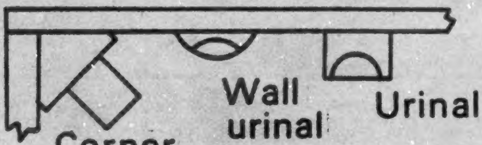


Single bowl sink

Double bowl sink



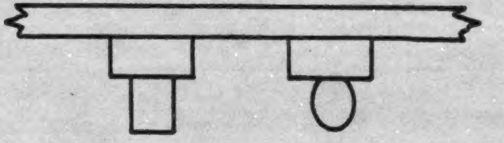
Double drainboard sink with cabinet



Corner water closet

Wall urinal

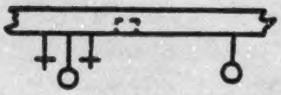
Urinal



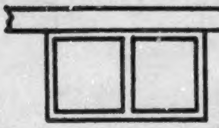
Toilet stools or water closets

Plumbing Symbols

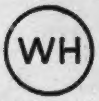
(Continued)



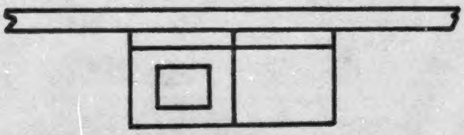
Shower heads



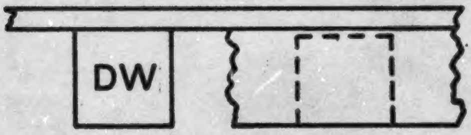
Laundry tubs



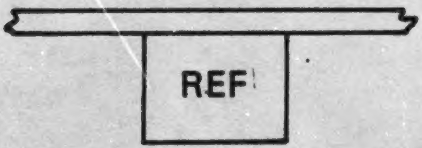
Water heater (designate capacity and fuel)



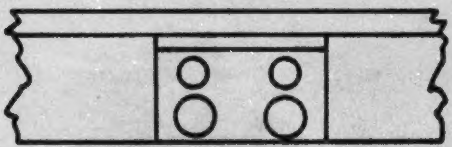
Washer and dryer



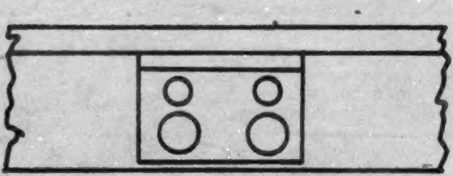
Freestanding and built-in dishwashers



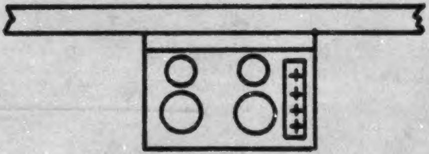
Refrigerator or freezer



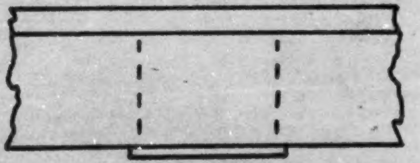
Freestanding range



Drop-in range

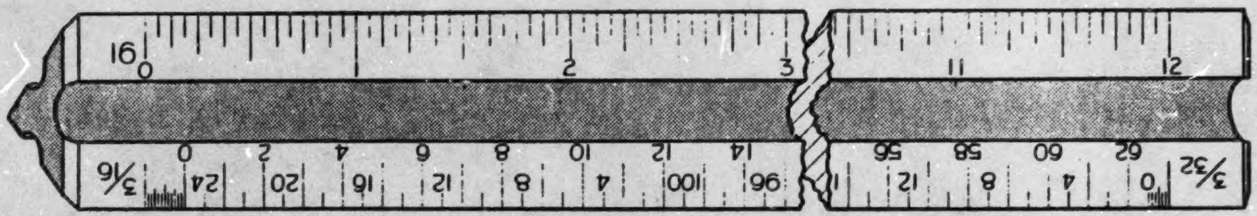


Surface cook top

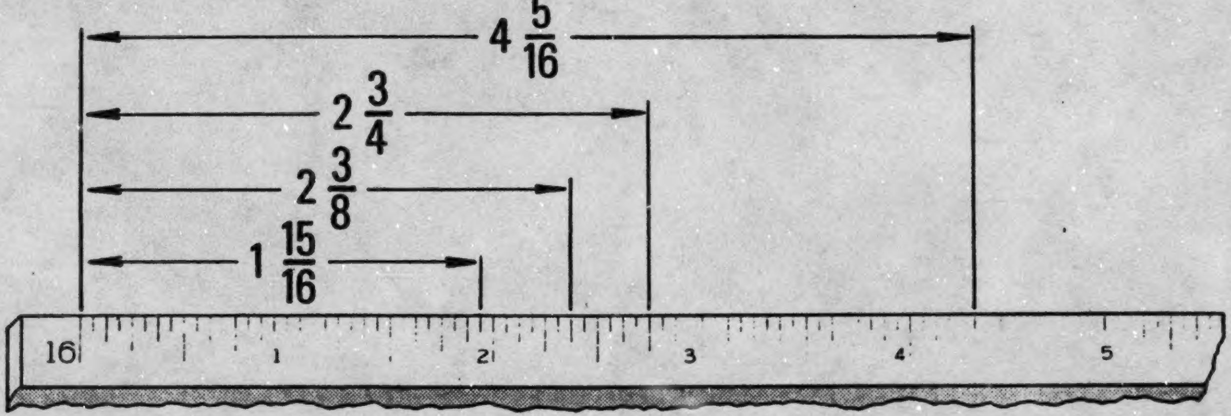


Built-in oven

The Architect's Scale

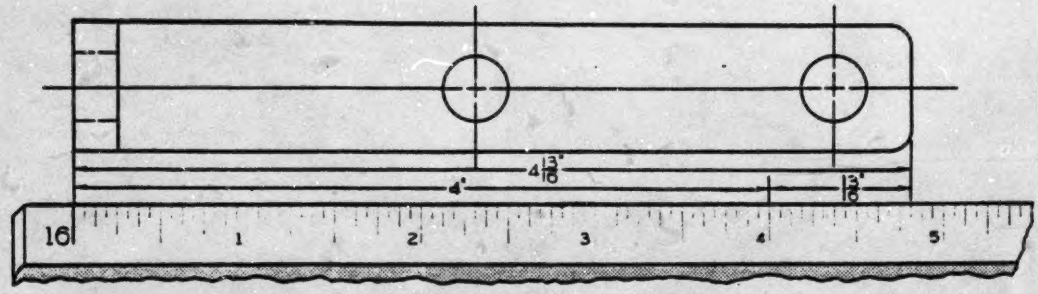

16
0
1
2
3
11
12
3/16
0
2
4
6
8
10
12
14
24
20
16
12
8
4
100
96
56
58
60
62
3/32
0
4
8
12

This is how the Architect's Scale should look.

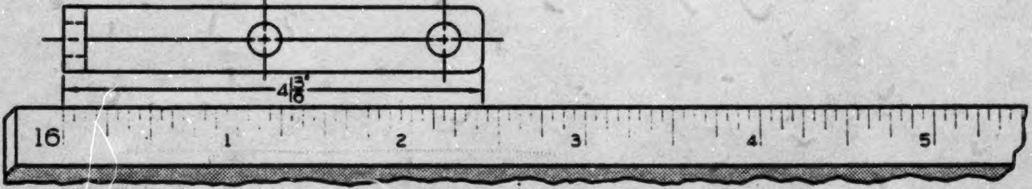

4 5/16
2 3/4
2 3/8
1 15/16
16
1
2
3
4
5

Measurements at Scale of 12" = 1'-0"

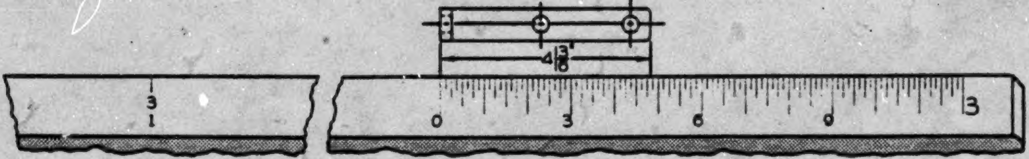
Comparison of Solid Objects


4 13/16"
4"
13/16"
16
1
2
3
4
5

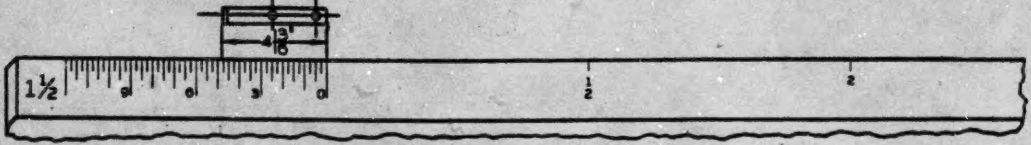
Full Scale 12" = 1'-0"


4 13/16"
16
1
2
3
4
5

Half Scale 6" = 1'-0"


4 13/16"
3
1
0
3
6
9
3

One-Fourth Scale 3" = 1'-0"

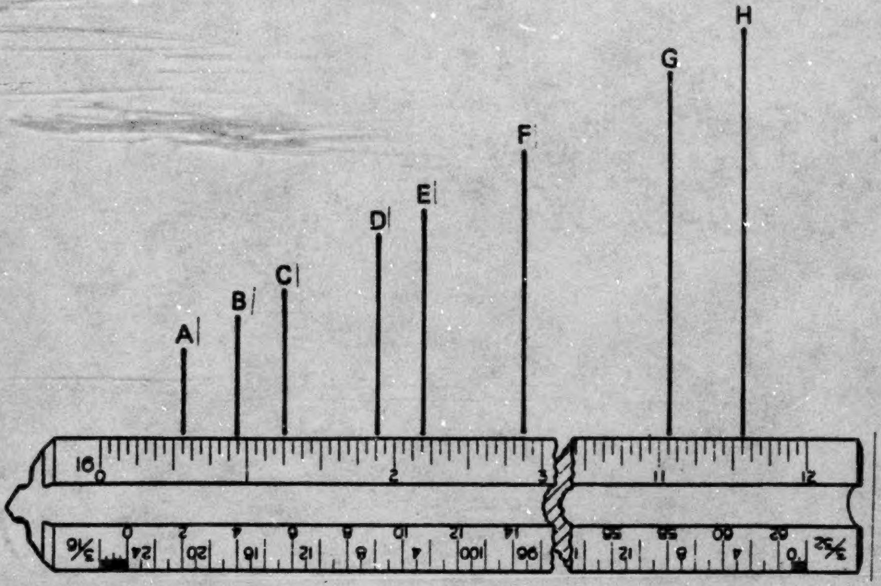

4 13/16"
1½
9
6
3
0
1
2

One-Eighth Scale 1½" = 1'-0"

BLUEPRINT READING
UNIT I

ASSIGNMENT SHEET #1--READ THE ARCHITECT'S SCALE AT FULL SCALE OR (12" = 1'0")

Read the measurements shown below at full scale by reading the distance from "0" at left to points indicated on the scale with letters.



1. A =

2. B =

3. C =

4. D =

5. E =

6. F =

7. G =

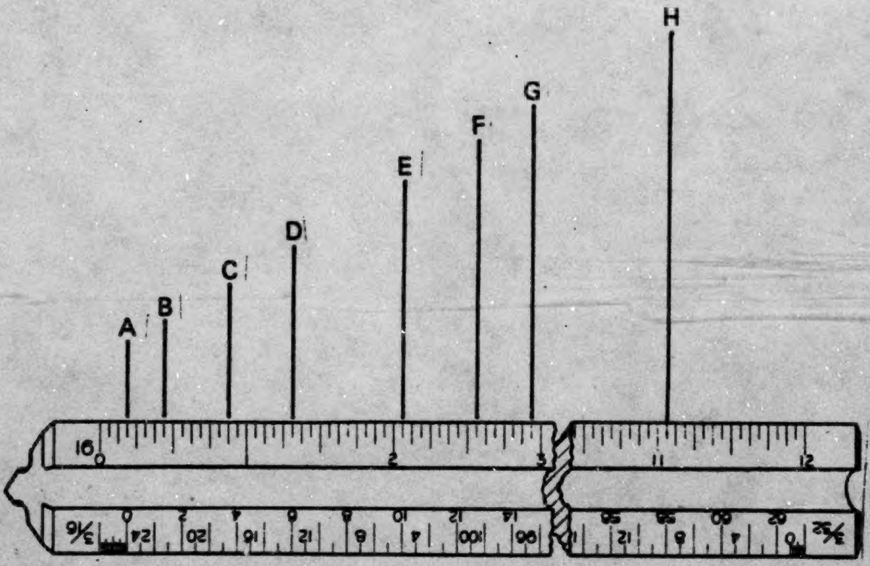
8. H =

P-55-C

BLUEPRINT READING
UNIT I

ASSIGNMENT SHEET #2–READ THE ARCHITECT'S SCALE AT HALF SCALE OR (6" = 1'0")

Read the measurements shown below at half scale by reading the distance from "0" at left to points indicated on the scale with letters



H
G
F
E
D
C
B
A
16
0
2
3
11
12
3/16
3/32

1. A =

2. B =

3. C =

4. D =

5. E =

6. F =

7. G =

8. H =

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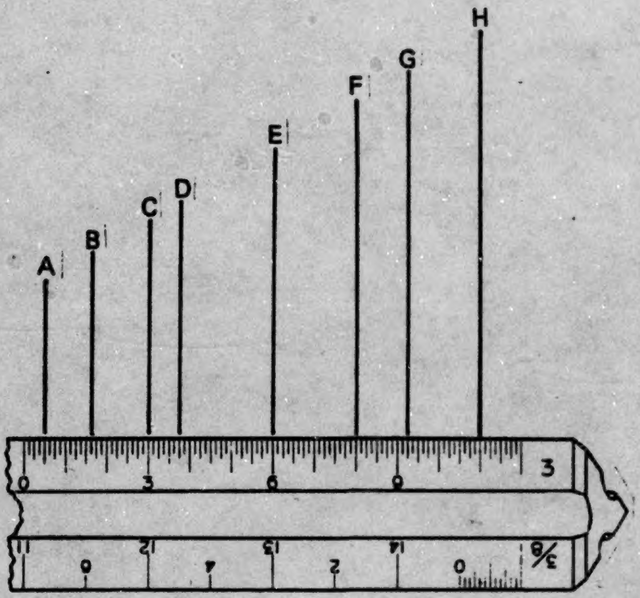
D-51-C

BLUEPRINT READING
UNIT I

ASSIGNMENT SHEET #3-READ THE ARCHITECT'S SCALE AT ONE-FOURTH SCALE OR (3" = 1'0")

Read the measurements shown below at quarter scale by reading the distance from "0" at left to points indicated on the scale with letters.

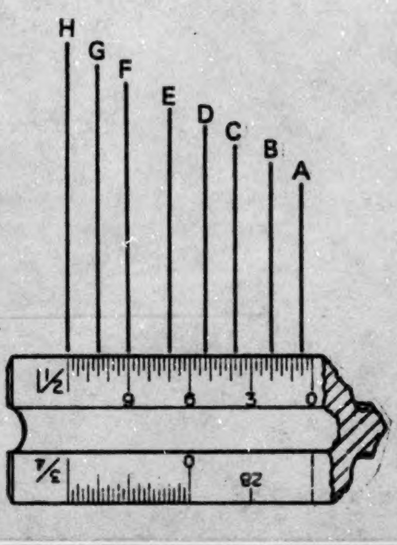


1. A =
2. B =
3. C =
4. D =
5. E =
6. F =
7. G =
8. H =

BLUEPRINT READING
UNIT I

ASSIGNMENT SHEET #4--READ THE ARCHITECT'S SCALE AT ONE-EIGHTH SCALE OR (1 1/2" = 1'0")

Read measurements shown below at eighth scale by reading the distance from "0" at right to points indicated on the scale with letters.



1. A =
2. B =
3. C =
4. D =
5. E =
6. F =
7. G =
8. H =

BLUEPRINT READING
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1. 9/16"
2. 15/16"
3. 1 1/4"
4. 1 7/8"
5. 2 3/16"
6. 2 7/8"
7. 11 1/16"
8. 11 9/16"

Assignment Sheet #2

1. 3/8"
2. 7/8"
3. 1 3/4"
4. 2 5/8"
5. 4 1/8"
6. 5 1/8"
7. 5 7/8"
8. 22 1/8"

Assignment Sheet #3

1. 1/2"
2. 1 5/8"
3. 3"

4. 3 3/4"
5. 6"
6. 8"
7. 9 1/4"
8. 11"

Assignment Sheet #4

1. 1/2"
2. 2"
3. 3 3/4"
4. 5 1/4"
5. 7"
6. 9"
7. 10 1/2"
8. 12"

BLUEPRINT READING
UNIT I

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions.

______a. A drawing of an object that has been cut to show internal construction

______b. A technical drawing which includes all dimensions and procedures to guide workers in the construction of a building

______c. A detailed set of written instructions which explains the drawing and becomes part of the contract

______d. An arbitrary sign that has been standardized and is used to represent an object, quality, or method

______e. Collection of laws listed in booklet form that apply to a given community, state, or nation

______f. Step by step directions which are shown in picture form

______g. A drawing that gives complete detailed information for the construction of a single part

______h. Set of conventional symbols covering all the lines needed to depict an object as to size an shape

______i. The arrangement of lines and symbols to indicate the actual size for constructing the object that is represented

______j. Horizontal cut through a building showing the foundation, rooms, partitions, windows, doors, and stairs

______k. A rule divided into proportional feet and inches; a fraction of an inch is proportionally equal to one foot

______l. Angle of roof designed to drain rain water and also adds to beauty of the building

1. Alphabet of lines
2. Architect's scale
3. Architectural drawings
4. Blueprint
5. Building code
6. Detail view
7. Dimensions
8. Roof pitch
9. Plan view
10. Scale drawing
11. Section view
12. Specifications
13. Symbol
14. Working drawing
15. Elevation view

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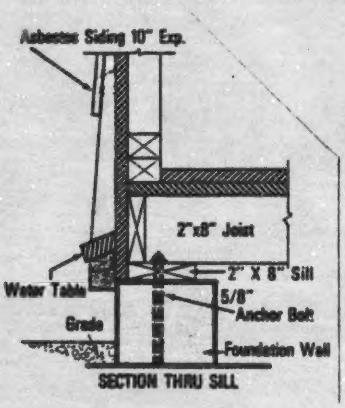
P-L5-C

_____m. Drawings representing the front, sides, or rear face of a building and usually made as though the observer were looking straight at it

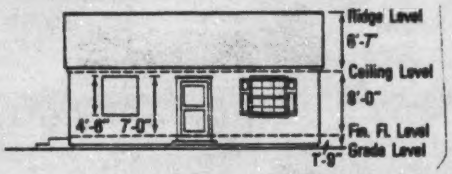
_____n. A copy of the original detailed drawing

_____o. A drawing made to a size either proportionally larger or smaller than the actual size of the object represented

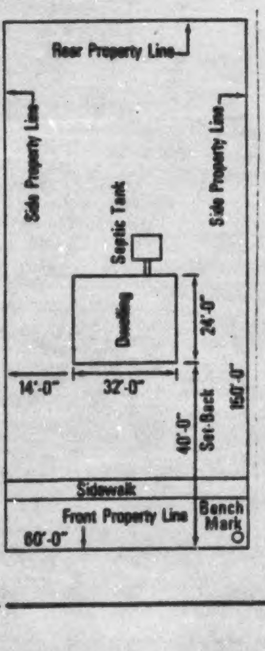
2. Identify the five types of architectural drawings pictured below.


Asbestos Siding 10" Exp.
2"x8" Joist
2" X 8" Sill
Water Table
5/8" Anchor Bolt
Grade
Foundation Wall
SECTION THRU SILL

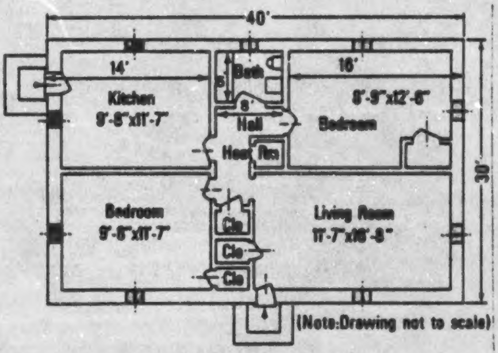
a. ______________________


Ridge Level
6'-7"
Ceiling Level
8'-0"
4'-6"
7'-0"
Fin. Fl. Level
1'-9"
Grade Level

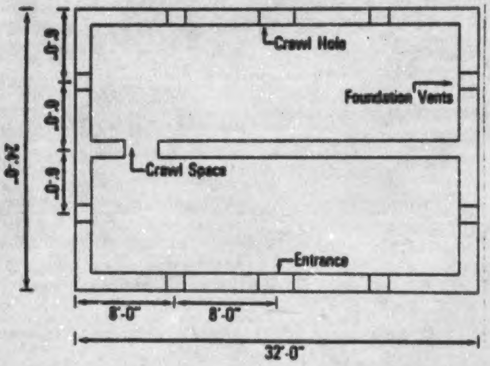
b. ______________________


Rear Property Line
Side Property Line
Septic Tank
Side Property Line
Dwelling
24'-0"
14'-0"
32'-0"
40'-0"
Set-Back
150'-0"
Sidewalk
Front Property Line
Bench Mark
60'-0"

c. ______________________


40'
14'
16'
Bath
Kitchen
9'-8"x11'-7"
8'
8'-9"x12'-8"
Hall
Bedroom
Heat Rm
30'
Bedroom
9'-8"x11'-7"
Clo
Clo
Clo
Living Room
11'-7"x16'-8"
(Note:Drawing not to scale)

d. ______________________


Crawl Hole
Foundation Vents
6'-0"
6'-0"
6'-0"
24'-0"
Crawl Space
Entrance
8'-0"
8'-0"
32'-0"

e. ______________________

3. Identify the types of lines shown below.

a.______________________

b.______________________

c.______________________

d.______________________

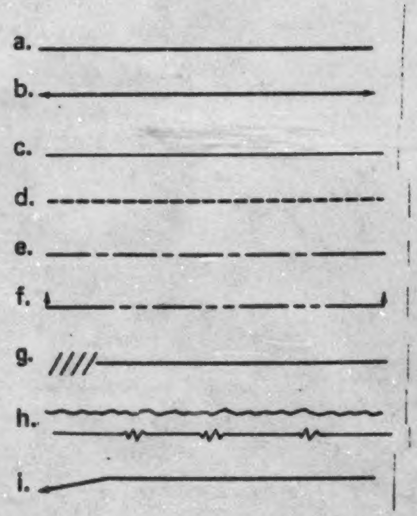
e.______________________

f.______________________

g.______________________

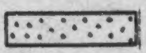
h.______________________

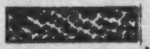
i.______________________

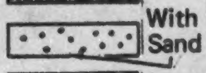


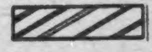
4. Match the name of the drawing symbols to the pictures of the symbols.

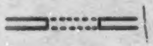
a. Floor plan

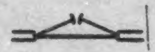
_____1) 

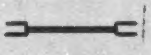
_____2) 

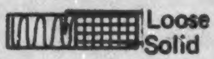
_____3) 

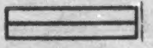
_____4) 

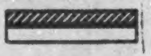
_____5) 

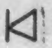
_____6) 

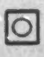
_____7) 

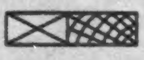
_____8) 

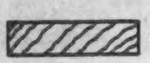
_____9) 

_____10) 

_____11) 

_____12) 

_____13) 

_____14) 

a) Brick veneer

b) Arch--Cased opening

c) Casement window

d) Cinders

e) Earth

f) Gravel

g) Double-hung window

h) Telephone jack

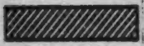
i) Structural steel or iron

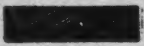
j) Insulation

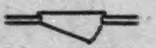
k) Flashing, termite barrier, waterproofing

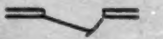
l) Tile--Hollow, Terra-Cotta

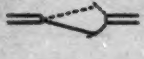
m) Outside door

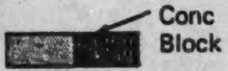
_____ 15) 

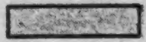
_____ 16) 

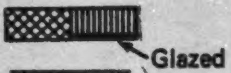
_____ 17) 

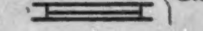
_____ 18) 

_____ 19) 

_____ 20) 

_____ 21) 

_____ 22) 

_____ 23) 

n) Inside door

o) Double-acting door

p) Wood (rough)

q) Wood (finished)

r) Brick

s) Firebrick

t) Concrete

u) Sand, plaster, cement, gypsum board

v) Floor drain

w) Glass

b. Electrical

_____ 1) Ceiling outlet

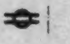
_____ 2) Wall bracket outlet

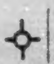
_____ 3) Duplex outlet

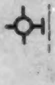
_____ 4) Switch (single pole)

_____ 5) Switch (3 way)

a) S_3

b) 

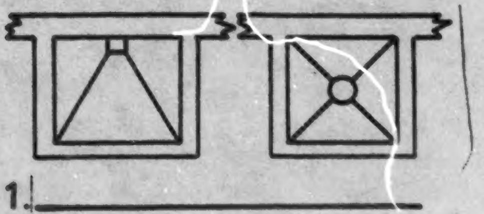
c) 

d) 

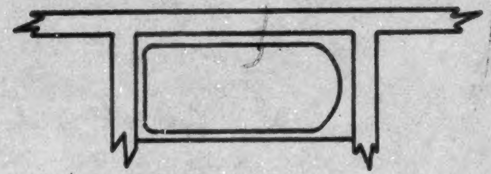
e) S_1

5. Identify plumbing, appliance, and structural symbols.

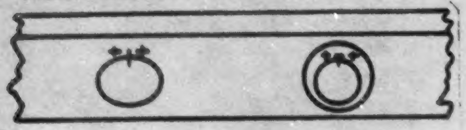
a. Plumbing symbols



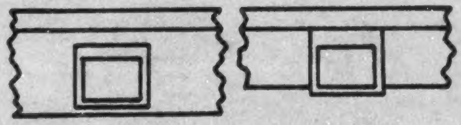
1. ______________________



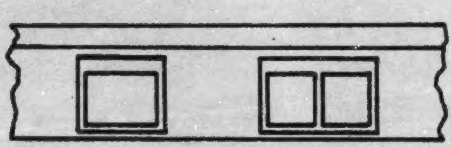
2. ______________________



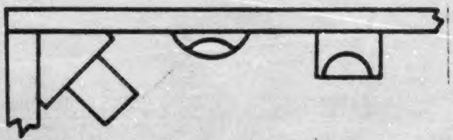
3. ______________________



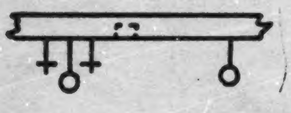
4. ______________________



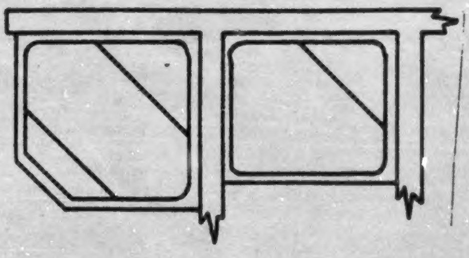
5. ______________ 6. ______________



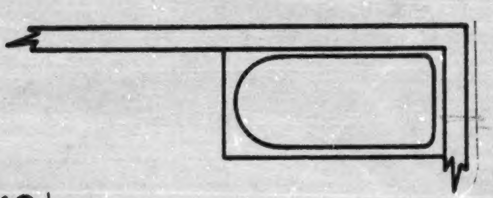
7. ______ 8. ______ 9. ______



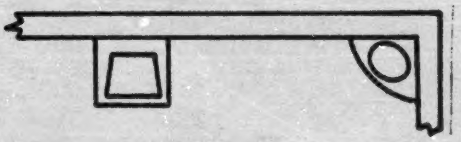
10. ______________________________



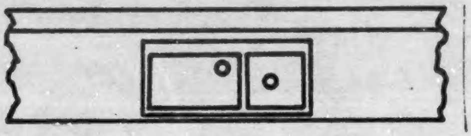
11. ______________ 12. ______________



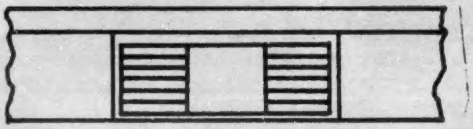
13. ______________________________



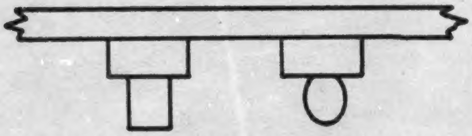
14. ______________ 15. ______________



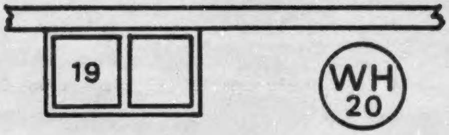
16. ______________________________



17. ______________________________

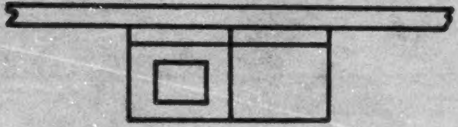


18. ______________________________

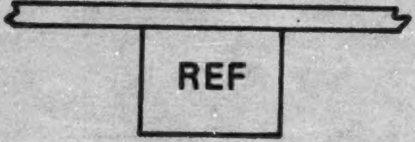


19. ______________ 20. ______________

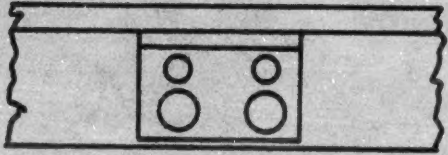
b. Appliance symbols



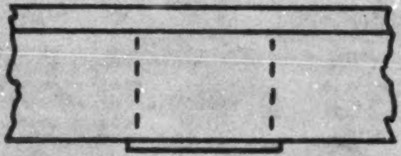
1. ______________________



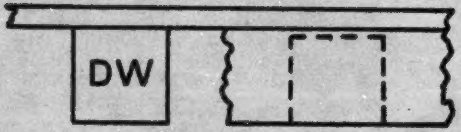
2. ______________________



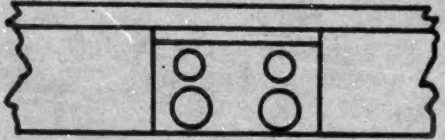
3. ______________________



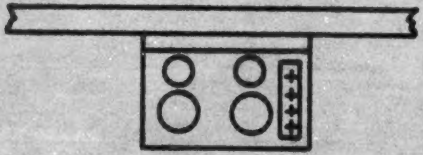
4. ______________________



5. ______________________

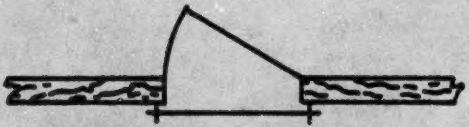


6. ______________________

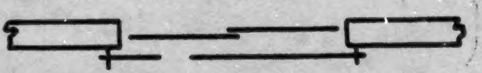


7. ______________________

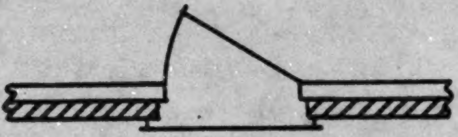
c. Structural symbols



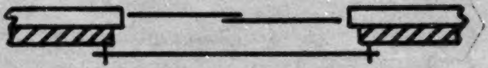
1. ____________________



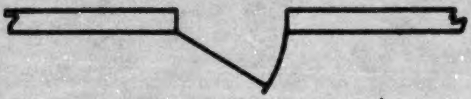
2. ____________________



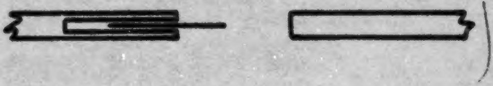
3. ____________________



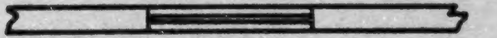
4. ____________________



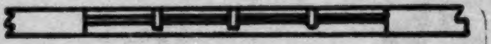
5. ____________________



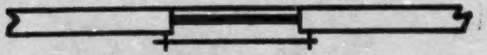
6. ____________________



7. ____________________



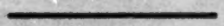
8. ____________________

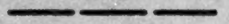


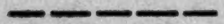
9. ____________________

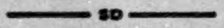
6. Match the name of the plumbing blueprint symbols on the right to the correct picture of the symbol.

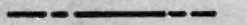
(NOTE: Answers for a - u are on this page.)

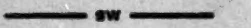
______ a. 

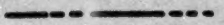
______ b. 

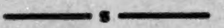
______ c. 

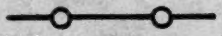
______ d. 

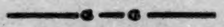
______ e. 

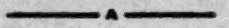
______ f. 

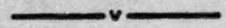
______ g. 

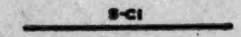
______ h. 

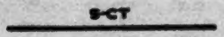
______ i. 

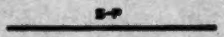
______ j. 

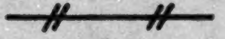
______ k. 

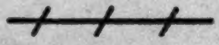
______ l. 

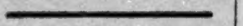
______ m. 

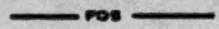
______ n. 

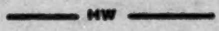
______ o. 

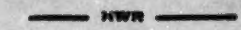
______ p. 

______ q. 

______ r. 

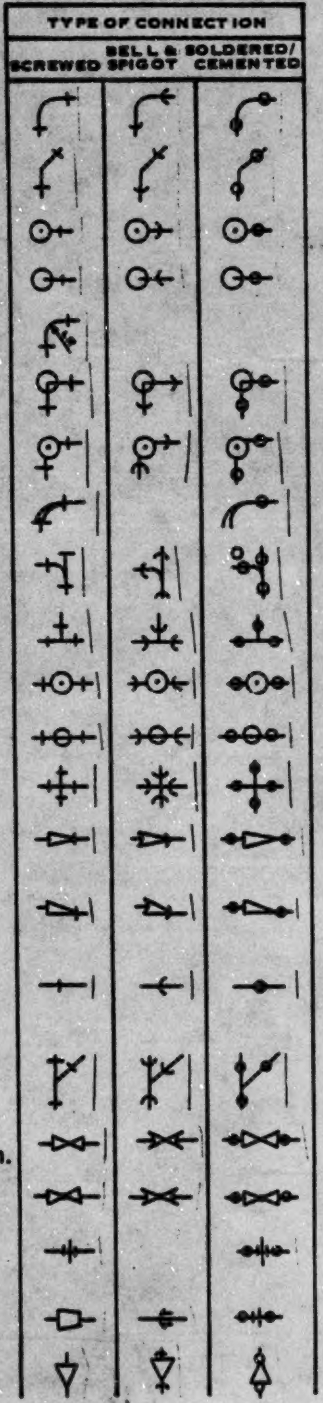
______ s. 

______ t. 

______ u. 

1. Soft cold water
2. Vacuum
3. Low-pressure steam
4. Hot water heating return
5. Drain or waste above ground
6. Hot water
7. Compressed air
8. Medium-pressure steam
9. Vent
10. Sewer--cast iron
11. Fuel oil supply
12. Storm drain
13. Drain or waste below ground
14. Sprinkler branch and head
15. Sewer--plastic
16. Hot water heating supply
17. Gas
18. Cold water
19. Sewer--clay tile
20. High-pressure steam
21. Sprinkler main

(NOTE: Answers for v - qq are on this page.)


TYPE OF CONNECTION
SCREWED
BELL & SPIGOT
SOLDERED/ CEMENTED

______v.

______w.

______x.

______y.

______z.

______aa.

______bb.

______cc.

______dd.

______ee.

______ff.

______gg.

______hh.

______ii.

______jj.

______kk.

______ll.

______mm.

______nn.

______oo.

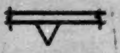
______pp.

______qq.

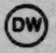
22. Sanitary T
23. Connector
24. Increaser
25. Elbow - 90 degrees
26. Elbow - Long radius
27. T - outlet up
28. Y or wye
29. Union
30. Elbow - 45 degrees
31. Elbow with side inlet-outlet up
32. Reducer - concentric
33. Valve - gate
34. Bushing
35. Elbow - turned up
36. Reducing elbow
37. T - outlet down
38. Reducer - offset (eccentric)
39. Cross
40. Valve - globe
41. Elbow with side inlet - outlet down
42. T
43. Elbow - turned down

(NOTE: Answers for rr - zz are on this page.)

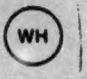
_____rr.



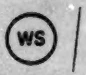
_____ss.



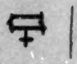
_____tt.



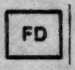
_____uu.



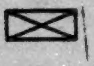
_____vv.



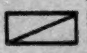
_____ww.



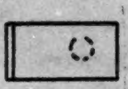
_____xx.



_____yy.



_____zz.

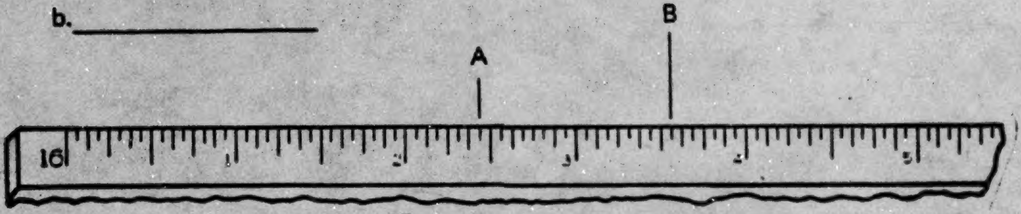


25. Hose bib
26. Heating unit
27. Vacuum outlet
28. Supply air duct
29. Floor drain
30. Water softener
31. Water heater
32. Dry well
33. Return air duct

7. Read the measurements at the following scales.

a. ____________________

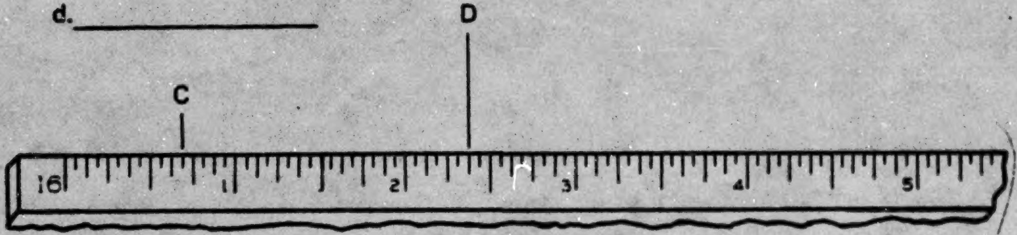
b. ____________________



Full Scale (12" = 1'0")

c. ____________________

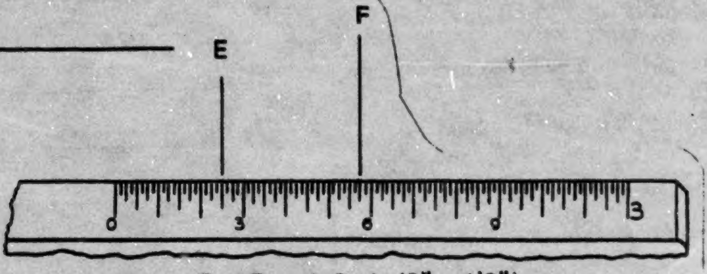
d. ____________________



Half Scale (6" = 1'0")

e. ____________________

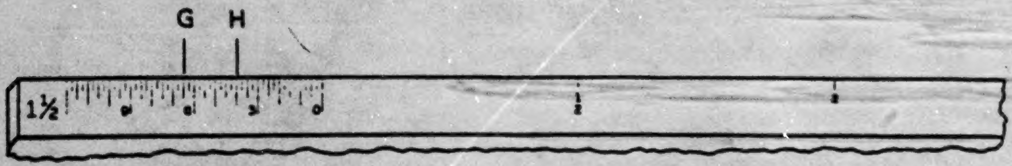
f. ____________________



One-Fourth Scale (3" = 1'0")

g. ____________________

h. ____________________



One-Eighth Scale (1 1/2" = 1'0")

8. List ten major items that are included in a set of specifications.

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

9. Extract specific information from the prepared set of building specifications below.

a. Color of bathtub fixture ____________________

b. Manufacturer of kitchen sink ____________________

c. Material and type for service pipe ____________________

d. Location of air chambers ____________________

e. Adhere to which plumbing code ____________________

f. Material and type of water pipe ____________________

g. Material and type of underground pipe ____________________

h. Type of sillcocks ____________________

i. City sewer lateral location ____________________

j. Material and type of vent piping ____________________

This contractor shall install a complete plumbing system as per these plans and specifications.

All water piping shall be copper type "L"

All above ground drainage and vent piping shall be copper DWV

Underground drainage pipe shall be cast iron

All plumbing must adhere to the local plumbing code

Building drain must be connected to city sewer lateral at curb

Service pipe must be copper type K and connected at curb and meter

All fixtures must be provided with air chambers on their water distribution pipes

Outside sillcocks must be 12" freeze-proof type

Fixtures:

Kitchen Sink--Acme "Master Chef" #7940 - Avocado

Bath--Acme "Salt Wara" #8016 - Blue

Lavatory--Acme "Hanwas" #122 - Blue

Water Closet--Acme "Wasam" #16 - Blue

Sink fitting--Groget "Klin" #8786

Lavatory fitting--Groget "Nogot" #88

Bath-Shower fitting--Groget "Long Wara" #32124

The owner reserves the right to make changes by negotiating the contract

BLUEPRINT READING
UNIT I

ANSWERS TO TEST

1. a. 11
   b. 14
   c. 12
   d. 13
   e. 5
   f. 3
   g. 6
   h. 1
   i. 7
   j. 9
   k. 2
   l. 8
   m. 15
   n. 4
   o. 10
2. a. Details
   b. Front elevation
   c. Plot plan
   d. Floor plan
   e. Foundation plan
3. a. Object line
   b. Dimension line
   c. Extension line
   d. Hidden line

e. Center line

f. Cutting-plane line

g. Section line

h. Break line

i. Leader

4. a. 1) d

2) e

3) f

4) i

5) b

6) c

7) g

8) j

9) k

10) a

11) h

12) v

13) p

14) q

15) r

16) s

17) m

18) n

19) o

20) t

21) u

22) l

23) w

b. 1) c 3) b 5) a

2) d 4) e

5. a. 1) Showers

2) Built-in bathtub

3) Built-in lavatories

4) Built-in lavatories

5) Single bowl sink

6) Double bowl sink

7) Corner water closet

8) Wall urinal

9) Urinal

10) Shower heads

11) Square corner tub

12) Built-in square tub

13) Corner bathtub

14) Wall hung lavatory

15) Corner lavatory

16) Shallow bowl sink

17) Double drainboard sink with cabinet

18) Water closets

19) Laundry tubs

20) Water heater

b. 1) Washer and dryer

2) Refrigerator or freezer

3) Drop-in range

4) Built-in oven

5) Freestanding and built-in dishwashers

6) Free-standing range

7) Surface cook top

c. 1) Plan view of exterior door in wood frame wall

2) Plan view of exterior sliding door in wood frame wall

3) Plan view of exterior door in masonry veneer wall

4) Plan view of exterior sliding door in masonry veneer wall

5) Plan view of interior hinged door

6) Plan view of interior pocket door

7) Single window in frame wall

8) Multiple windows in frame wall

9) Plan view of double hung window in frame wall

6. a. 5 or 3

b. 13

c. 9

d. 12

e. 18

f. 1

g. 6

h. 21

i. 14

j. 17

k. 7

l. 2

m. 10

n. 19

o. 15

p.	20
q.	8
r.	3 or 5
s.	11
t.	16
u.	4
v.	25
w.	30
x.	35
y.	43
z.	26
aa.	41
bb.	31
cc.	36
dd.	22
ee.	42
ff.	27
gg.	37
hh.	39
ii.	32
jj.	38
kk.	23
ll.	28
mm.	33
nn.	40
oo.	29
pp.	34

qq. 24
rr. 27
ss. 32
tt. 31
uu. 30
vv. 25
ww. 29
xx. 28
yy. 33
zz. 26

7. a. 2 7/16"
   b. 3 9/16"
   c. 1 3/8"
   d. 4 3/4"
   e. 2 1/2"
   f. 5 3/4"
   g. 6 1/2"
   h. 4"

8. Any ten of the following:
   a. Sizes
   b. Types and quality of building materials
   c. Methods of construction
   d. Types of material
   e. Owner's name and address
   f. Contractor's name and address
   g. Location of new structure
   h. Completion date
   i. Contractor's bid
   j. Guarantees

k. Method of payment

l. Manner of workmanship

m. Wages to be paid

9. a. Blue

b. Acme

c. Copper type "K"

d. Water distribution pipes on all fixtures

e. Local plumbing code

f. Copper type "L"

g. Cast iron

h. 12" freeze-proof type

i. Curb

j. Copper DWV

P-85-C

ISOMETRIC SKETCHING
UNIT II

UNIT OBJECTIVE

✓ After completion of this unit, the student should be able to match terms associated with isometric sketching and develop plan and isometric sketches. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with isometric sketching to definitions and descriptions.
2. Select true statements about plan sketches.
3. Select true statements about riser diagrams.
4. Select true statements about isometric sketches.
5. Develop three types of sketches of a drainage system in a basement floor.
6. Develop an isometric sketch of a drainage system.

P-87-C

ISOMETRIC SKETCHING
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

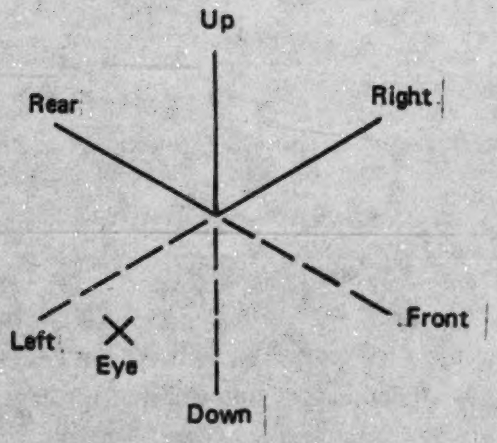
A. Provide student with objective sheet.

B. Provide student with information and assignment sheets.

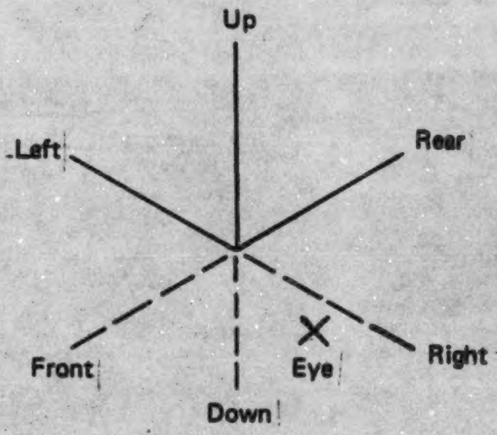
C. Make transparencies.

D. Discuss unit and specific objectives.

E. Draw the following illustration on the chalkboard.



Isometric Directions
Left Front Eye Position



Isometric Directions
Right Front Eye Position

This illustration will show how isometrics can best be understood by visualizing a house from a 30° angle with either the left or the right eye.

F. Give test.

II. Student:

A. Read objective sheet.

B. Study information sheet.

C. Complete assignment sheets.

D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
    - 1. TM 1--Plan Views
    - 2. TM 2--Riser Diagrams
    - 3. TM 3--Isometric Sketches
- D. Assignment Sheets
    - 1. Assignment Sheet #1--Develop Three Types of Sketches of a Drainage System in a Basement
    - 2. Assignment Sheet #2--Develop an Isometric Sketch of a Drainage System
- E. Test
- F. Answers to test

II. References:

- A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland: Ill: Goodheart-Willcox, 1978.
- B. D'Arcangelo, Et. Al., *Blueprint Reading for Plumbers.* Albany, New York: Delmar Publishing Company, 1973.

ISOMETRIC SKETCHING
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Plan--Shows piping system as viewed from directly above

B. Elevation view--Drawings representing the front, sides, or rear face of a building and usually made as though the observer were looking directly at the building

C. Isometric--A three dimensional picture in one drawing used by plumbers to get the "real" picture

D. Scale drawing--A drawing made to size either proportionately larger or smaller than the actual size of the object represented

E. Riser diagram--an elevation view of the piping system

II. Plan sketches (Transparency 1)

A. Plan view shows sketch as viewed from directly above (Figure 1)

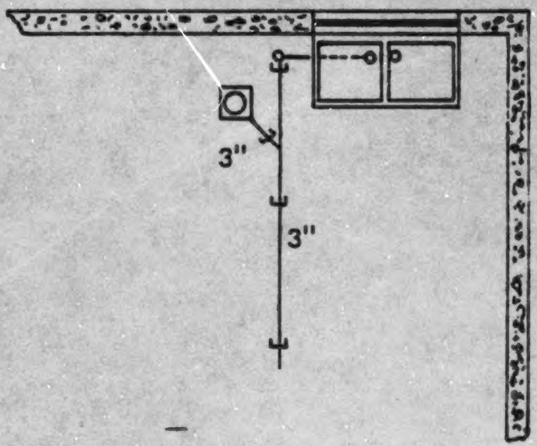


FIGURE 1

B. Plan view does not show pitch of pipe

C. Plan view can be used to determine:

1. Length of pipe
2. Location and types of fittings

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INFORMATION SHEET

3. Location of floor drains

4. Location of clean-outs

5. Direction of flow

6. Labor estimates

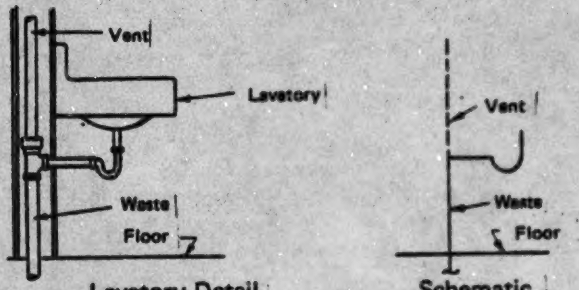
D. The plan view can serve as a record after the floor has been poured

E. The plan view should show all floor drainage including storm drainage and foundation drainage

III. Riser diagrams (Transparency 2)

A. Riser diagrams are a sectional view (schematic) through a building showing the piping system or part of a system

B. Riser diagrams are not a true picture due to sketch being two dimensional (Figure 2)


Vent
Lavatory
Waste
Floor
Vent
Waste
Floor

Lavatory Detail Schematic

FIGURE 2

C. Riser diagrams are valuable in determining code and inspection requirements (Figure 3)

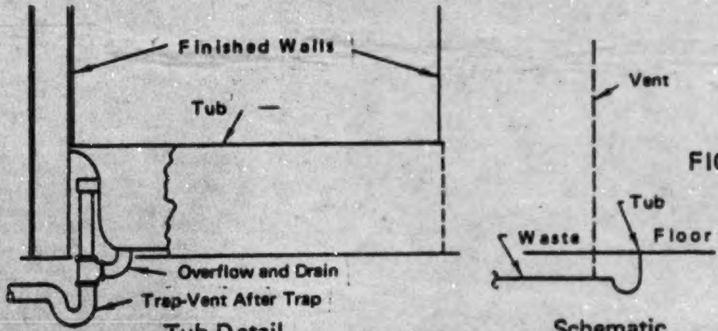

Finished Walls
Tub
Overflow and Drain
Trap-Vent After Trap
Vent
Tub
Waste
Floor

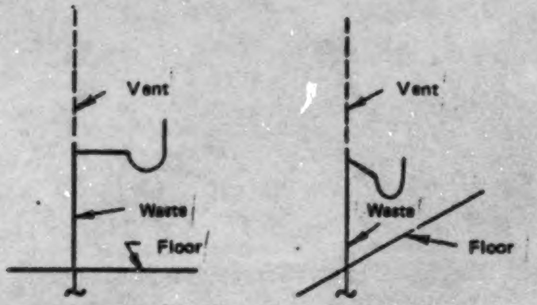
FIGURE 3

Tub Detail Schematic

INFORMATION SHEET

IV. Isometric sketches (transparency 3)

- A. Isometric sketches are used to show a three dimensional picture in one drawing
- B. Isometrics combine the plan and elevation views into one drawing
- C. Scale drawings of isometric views help to determine an accurate materials list
- D. Pipes that are vertical on a plan or elevation view, such as soil, water, and vent stacks, remain vertical in the isometric drawing
- E. Pipes that are horizontal on a plan or elevation view are shown at a 30° angle in the isometric drawing (Figure 4)



Schematic Isometric

FIGURE 4

Examples: This house, in outline form, would show the drainage system as horizontal lines, 30°; vertical lines, 90° (Figure 5)

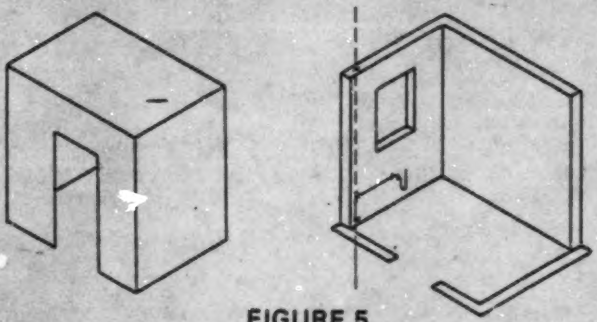


FIGURE 5

INFORMATION SHEET

This is the same system without the house lines (Figure 6)

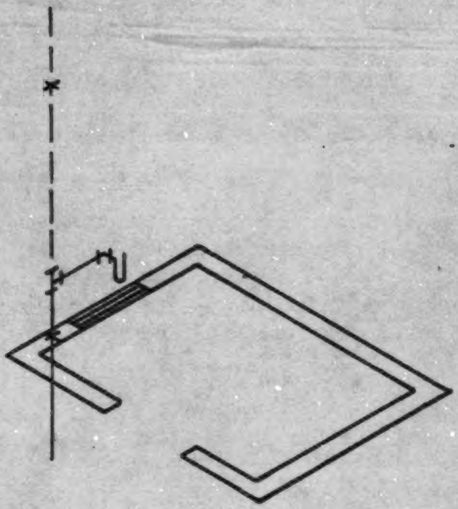


FIGURE 6

Careful consideration to detail can indicate type of fitting and direction of flow (Figure 7)

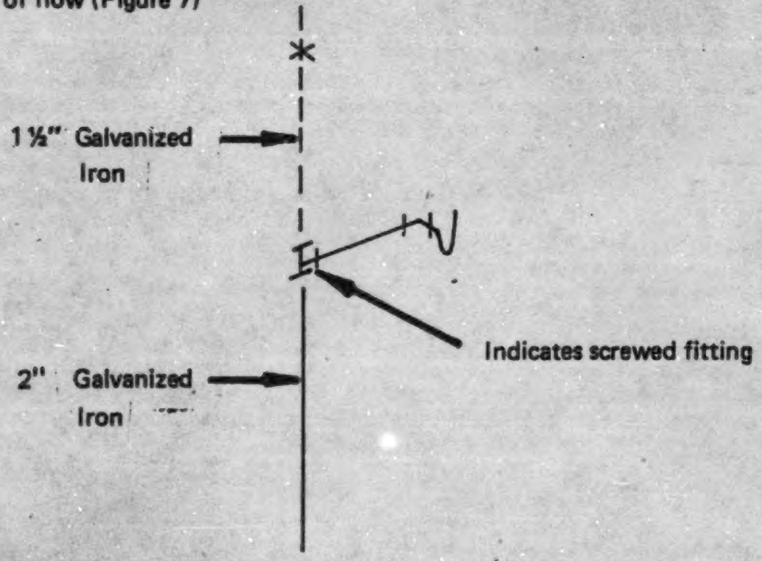
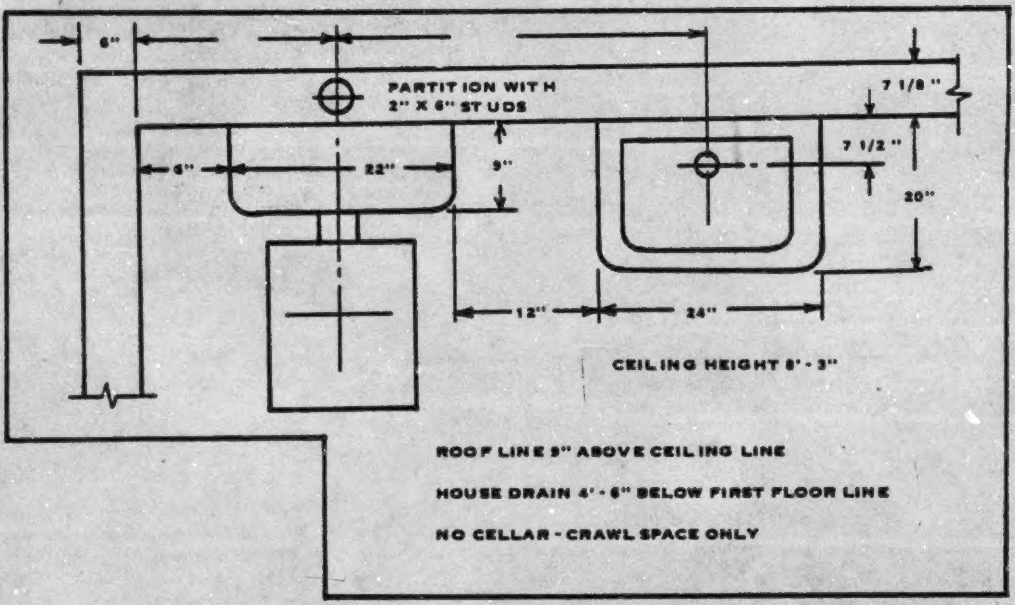

1 ½" Galvanized Iron
Indicates screwed fitting
2" Galvanized Iron

FIGURE 7

97-C

Plan Views

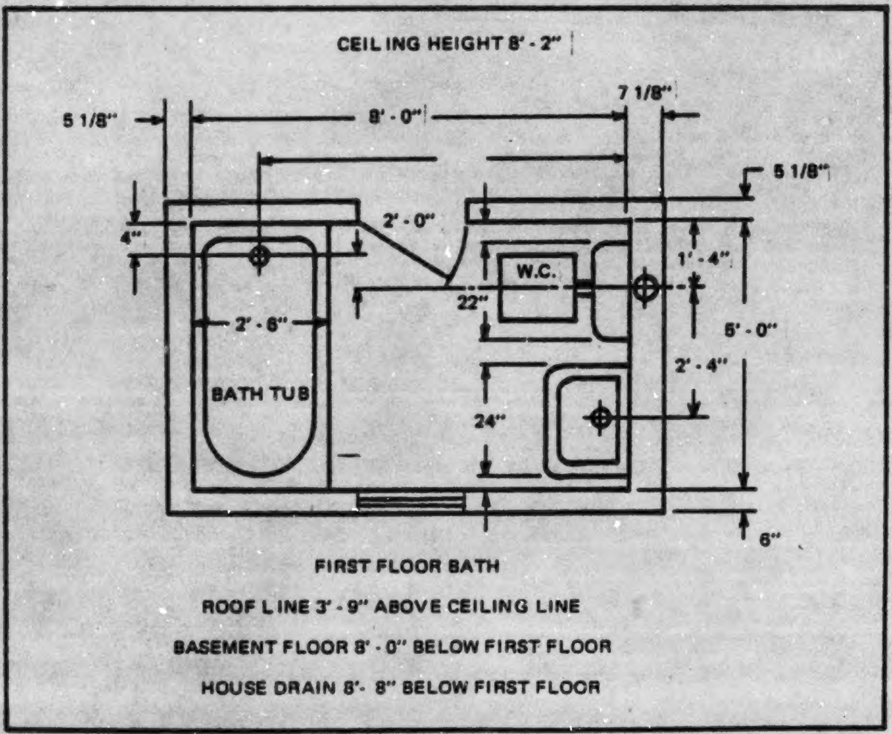

6"
PARTITION WITH
2" X 6" STUDS
7 1/8"
7 1/2"
6"
22"
9"
20"
12"
24"

CEILING HEIGHT 8' - 3"

ROOF LINE 9" ABOVE CEILING LINE

HOUSE DRAIN 4' - 6" BELOW FIRST FLOOR LINE

NO CELLAR - CRAWL SPACE ONLY


5 1/8"
8' - 0"
7 1/8"
5 1/8"
4"
2' - 0"
W.C.
22"
1' - 4"
2' - 6"
5' - 0"
2' - 4"
BATH TUB
24"
6"

CEILING HEIGHT 8' - 2"

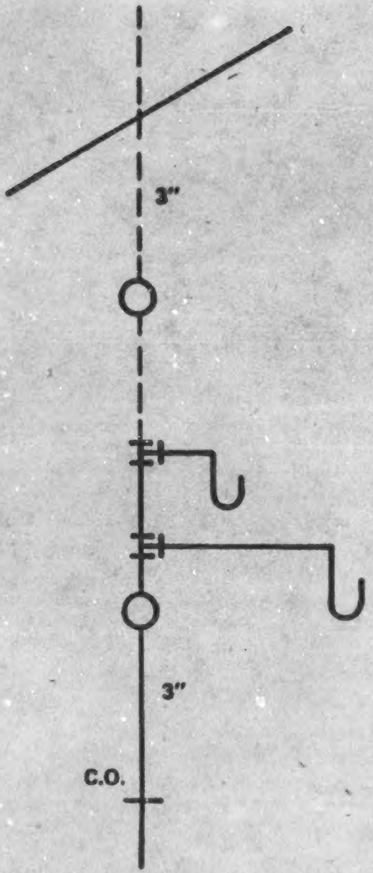
FIRST FLOOR BATH

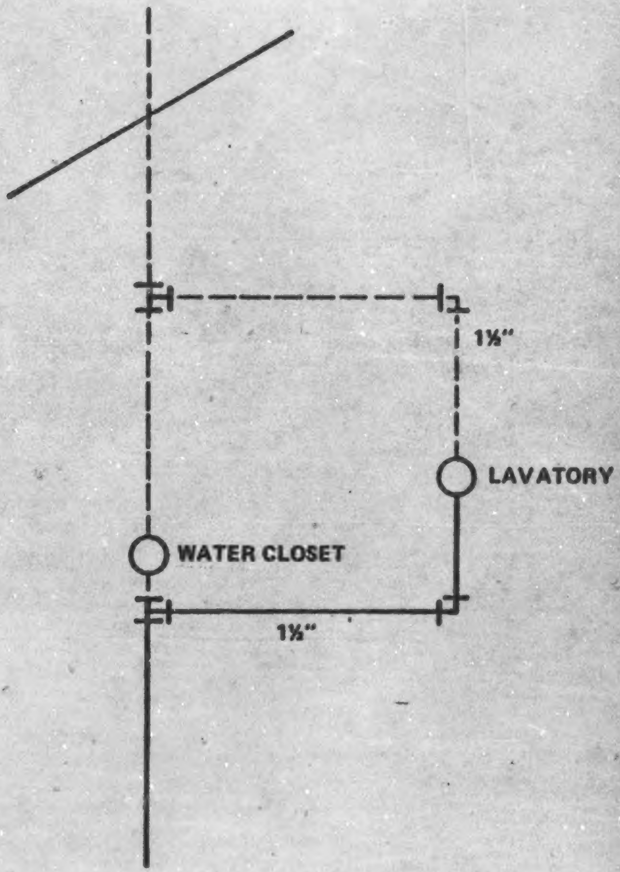
ROOF LINE 3' - 9" ABOVE CEILING LINE

BASEMENT FLOOR 8' - 0" BELOW FIRST FLOOR

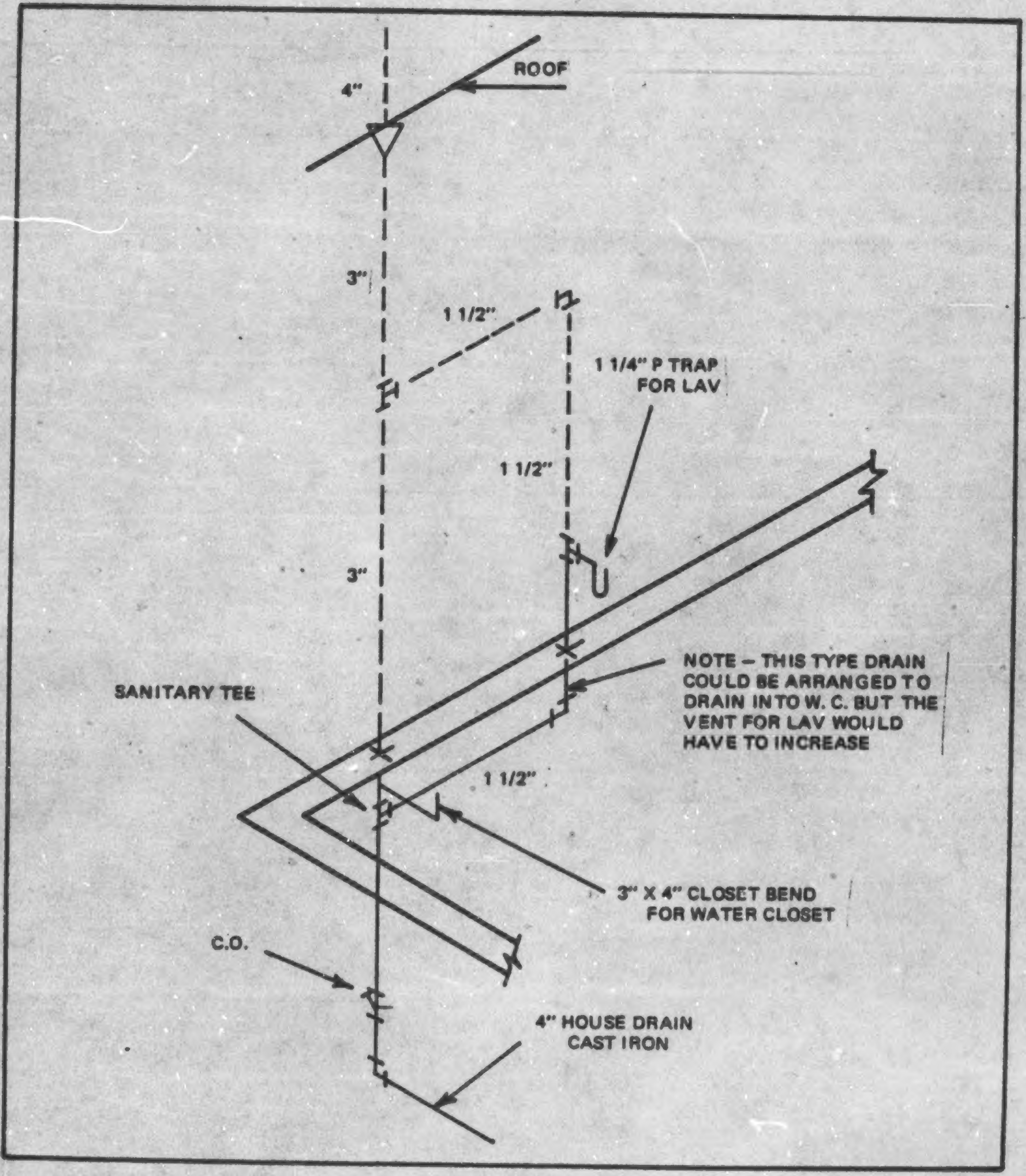
HOUSE DRAIN 8' - 8" BELOW FIRST FLOOR

Riser Diagrams




1½"
LAVATORY
WATER CLOSET
1½"

Isometric Sketch

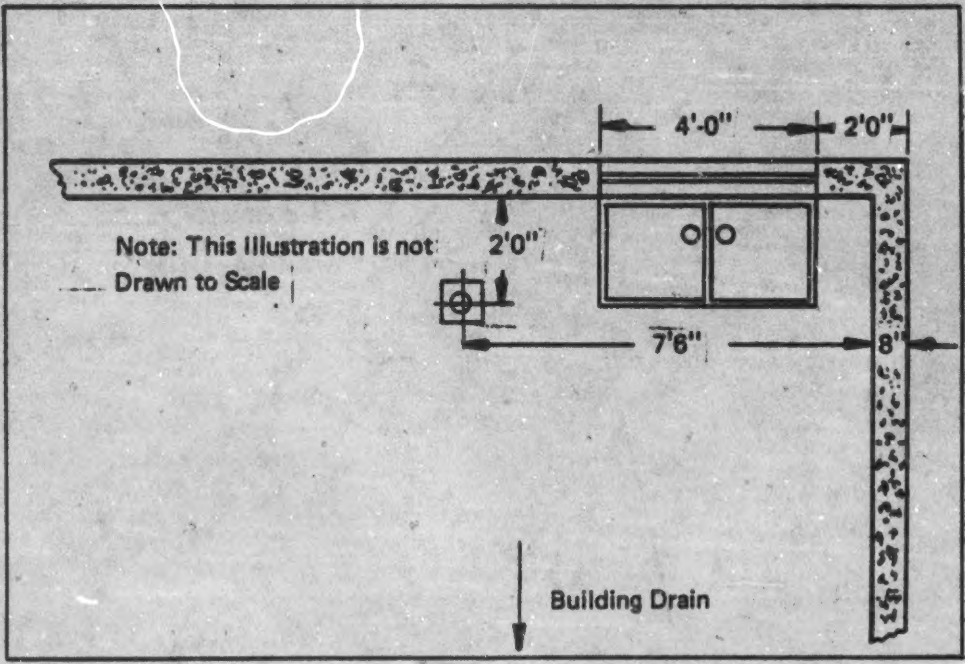

ROOF
4"
3"
1 1/2"
1 1/4" P TRAP FOR LAV
1 1/2"
3"
NOTE – THIS TYPE DRAIN COULD BE ARRANGED TO DRAIN INTO W. C. BUT THE VENT FOR LAV WOULD HAVE TO INCREASE
SANITARY TEE
1 1/2"
3" X 4" CLOSET BEND FOR WATER CLOSET
C.O.
4" HOUSE DRAIN CAST IRON

ISOMETRIC SKETCHING
UNIT II

ASSIGNMENT SHEET #1--DEVELOP THREE TYPES OF SKETCHES OF A DRAINAGE SYSTEM IN A BASEMENT FLOOR

A. Plan view

Direction: Develop a plan view of the drainage system of the following illustration of a basement, and show scale, building walls, window openings, and all piping.


4'-0"
2'0"
2'0"
Note: This Illustration is not Drawn to Scale
7'6"
8"
Building Drain

P-101-C

ASSIGNMENT SHEET #1

C. Isometric sketch

Directions: Using the illustration in section A, develop an isometric sketch of the drainage system.

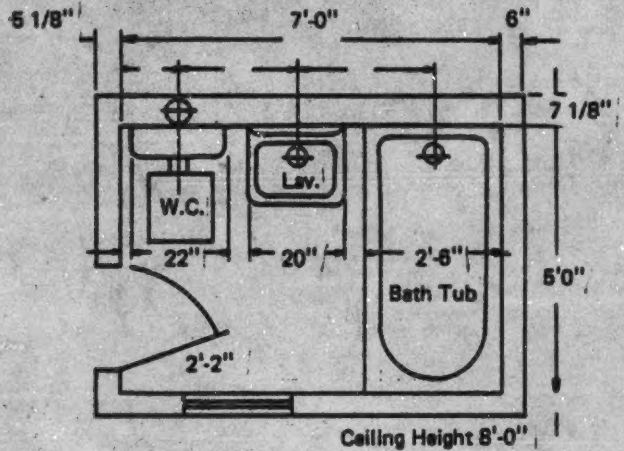
P-103-C

ISOMETRIC SKETCHING
UNIT II

ASSIGNMENT SHEET #2--DEVELOP AN ISOMETRIC SKETCH OF A DRAINAGE SYSTEM

Directions: Develop an isometric sketch showing the piping system for the following plan.

(NOTE: The scale to be used is 1/8" = 1'.)



(Note: Connect the waste for tub and lavatory to a separate Sanitary Tee just below the W.C. in the stock.)

FIGURE 1

I. Tools and materials

- A. Drawing board or large desk
- B. Triangle--45° (8" sides)
- C. Triangle--30° X 60° (10" long side)
- D. 2-H pencil
- E. Eraser
- F. Pencil sharpener
- G. Scale rule
- H. Paper or appropriate material

II. Procedure

- A. Note the scale to be used
- B. Draw drainage layout on the plan
- C. Draw an isometric view to scale

  (NOTE: Show inside or outside wall.)

P-105-C

ASSIGNMENT SHEET #2

D. Draw isometric view of all drainage piping

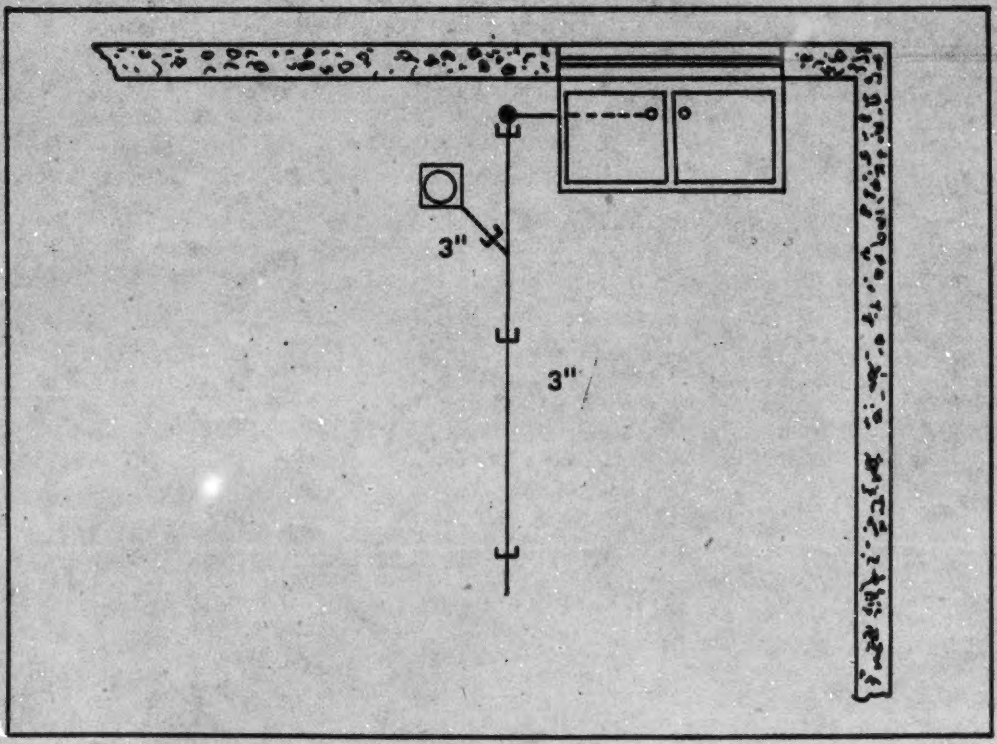
E. Size all piping according to local code or instructor's instructions

ISOMETRIC SKETCHING
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

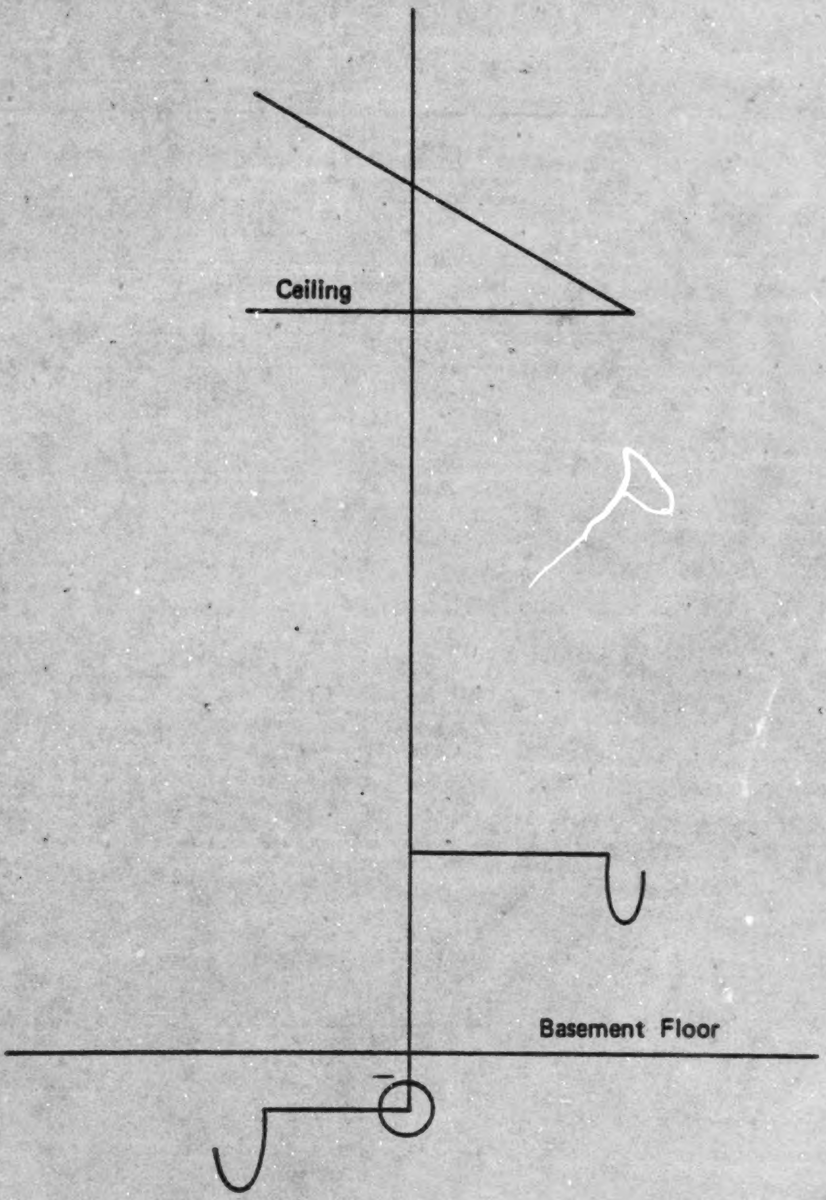
Assignment Sheet #1

A.

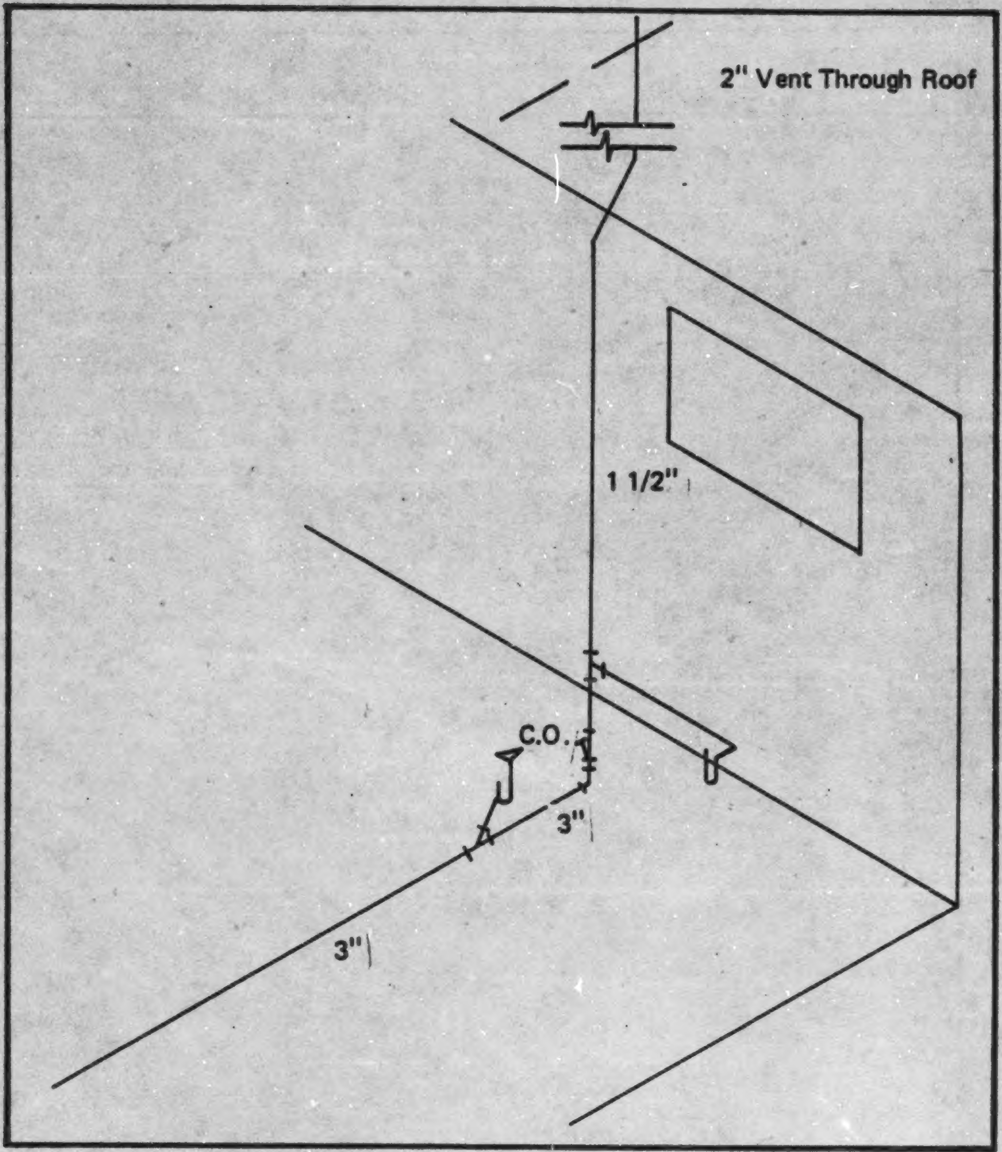


P-107-

B.

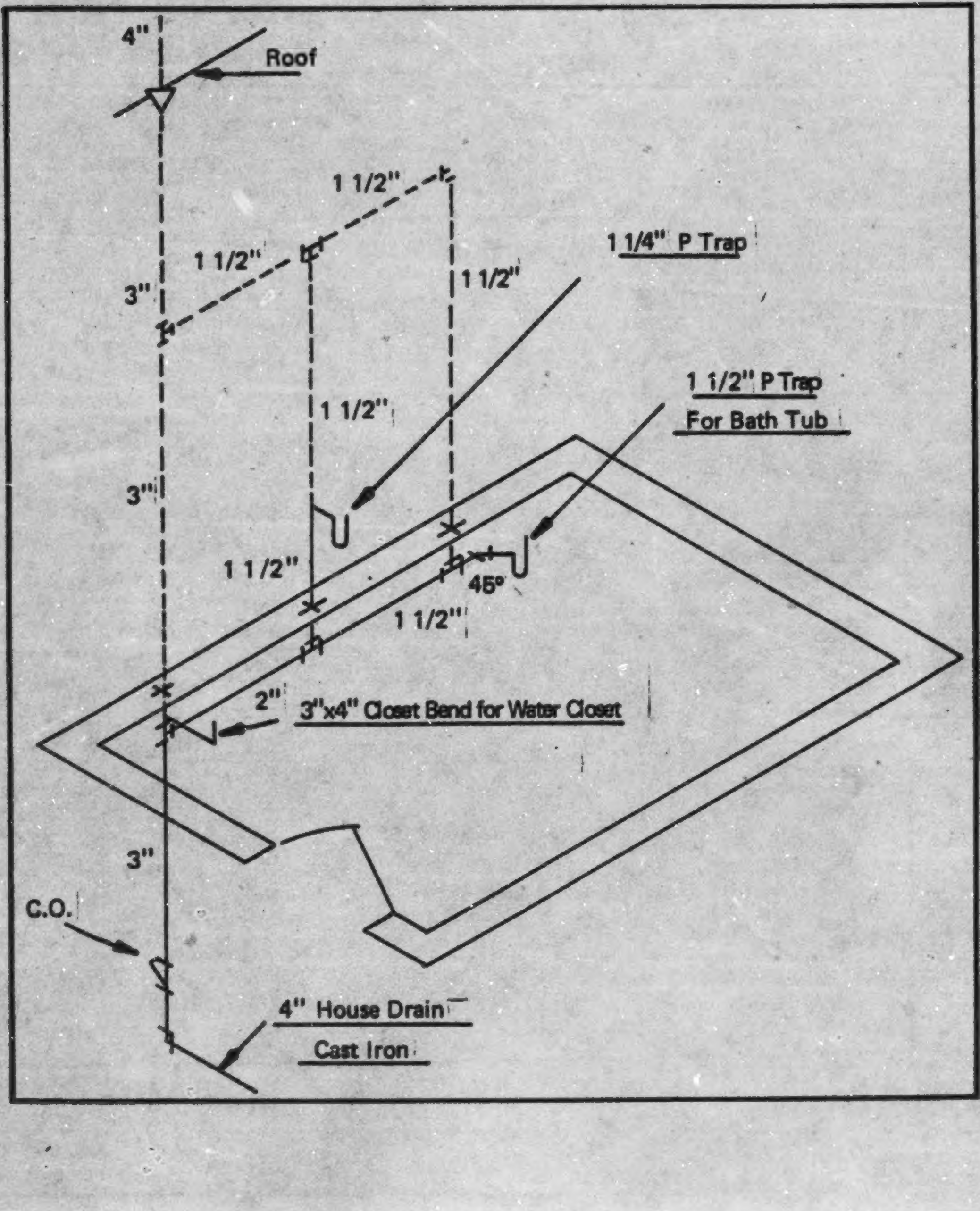

Ceiling
Basement Floor

C.


2" Vent Through Roof
1 1/2"
C.O.
3"
3"

P-109-C

Assignment Sheet #2


4"
Roof
1 1/2"
1 1/2"
1 1/4" P Trap
3"
1 1/2"
1 1/2"
1 1/2" P Trap
For Bath Tub
3"
1 1/2"
45°
1 1/2"
2"
3"x4" Closet Bend for Water Closet
3"
C.O.
4" House Drain
Cast Iron

110-C

ISOMETRIC SKETCHING
UNIT II

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

______a. Shows piping system as viewed from directly above

______b. Drawings representing the front, sides, or rear face of a building and usually made as though the observer were looking directly at the building

______c. A three dimensional picture in one drawing used by plumbers to get the "real" picture

______d. A drawing made to size either proportionately larger or smaller than the actual size of the object represented

______e. An elevation view of the piping system

1. Isometric
2. Scale drawing
3. Plan
4. Elevation view
5. Riser diagram

2. Select true statements about plan sketches by placing an "X" in the appropriate blanks.

______a. Plan view shows sketch as viewed from the side

______b. Plan view does not show pitch of pipe

______c. Plan view can be used to determine length of pipe

______d. Plan view can be used to determine direction of flow

______e. Plan view can be used to determine labor estimates

______f. Plan view can be used to determine height of sink

______g. The plan view cannot serve as a record after the floor has been poured

______h. The plan view should show all drainage including storm drainage and foundation drainage

P-111-C

3. Select true statements about riser diagrams by placing an "X" in the appropriate blanks.

______a. Riser diagrams are valuable in determining code and inspection requirements

______b. Riser diagrams are a true picture of the sketch since they are three dimensional

______c. Riser diagrams are a sectional view (schematic) through a building showing the piping system or part of a system

4. Select true statements about isometric sketches by placing an "X" in the appropriate blanks.

______a. Isometric sketches are used to show a three dimensional picture in one drawing

______b. Isometrics combine the take-off view and elevation view into one drawing

______c. Scale drawings of isometric views help to determine an accurate materials list

______d. Pipes that are vertical on a plan or elevation view, such as soil, water, and vent stacks, remain vertical in the isometric drawing

______e. Pipes that are diagonal on a plan or elevation view are shown at a 30° angle in the isometric drawing

5. Develop three types of sketches of a drainage system in a basement floor.

6. Develop an isometric sketch of a drainage system.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

ISOMETRIC SKETCHING
UNIT II

ANSWERS TO TEST

1. a. 3
   b. 4
   c. 1
   d. 2
   e. 5
2. b, c, d, e, h
3. a, c
4. a, c, d
5. Evaluated to the satisfaction of the instructor
6. Evaluated to the satisfaction of the instructor

ROUGH-IN LOCATIONS
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with rough-in locations, discuss methods by which rough-in locations are determined, read manufacturer's specifications and coordinate work with other tradesworkers. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with rough-in locations to the correct definitions or descriptions.
2. Name three individuals who could be responsible for determining rough-in locations.
3. Select factors concerning verbal orders.
4. Select factors concerning sketches.
5. Select factors concerning marking-out locations.
6. Select information commonly found on manufacturer's specifications.
7. List two pieces of information which can be determined from manufacturer's specifications.
8. List tradesworkers other than plumbers who work in residential construction.
9. Discuss cooperating and coordinating techniques between plumbers and other tradesworkers.
10. Demonstrate the ability to:
    a. Determine measurements from a manufacturer's specifications.
    b. Determine rough-in locations for a bathroom.
    c. Establish grade lines for installing plumbing.

ROUGH-IN LOCATIONS
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide student with objective sheet.
- B. Provide student with information, assignment, and job sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information sheets.
- F. Demonstrate and discuss the procedures outlined in the job sheets.
- G. Conduct a field trip to a construction site.
- H. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete assignment and job sheets.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
  1. TM 1--Manufacturer's Specifications - Water Closet Rough-in Sheet
  2. TM 2--Manufacturer's Specifications - Bathtub Rough-in Sheet
  3. TM 3--Manufacturer's Specifications - Lavatory Rough-in Sheet

P-117-C

D. Assignment sheet

  1. Assignment Sheet #1--Determine Measurements from a Manufacturer's Specifications

E. Job sheet

  1. Job Sheet #1--Determine Rough-in in Locations for a Bathroom

  2. Job Sheet #2--Establish Grade Lines for Installing Plumbing

F. Test

G. Answers to Test

II. Reference--Blankenbaker, E. Keith. *Modern Plumbing*. South Holland, IL: Goodheart-Willcox, 1978.

ROUGH-IN LOCATIONS
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Rough-in--Preparing for and installing those pipes which will be covered by walls, ceilings, floors, and could be exposed in the basement

B. Manufacturer's specifications--Drawings and directions supplied by fixture manufacturers which indicate exact size, shape and connections necessary to install the fixture

C. Slab construction--Concrete poured in a large flat surface which includes the entire house floor

D. Floor and ceiling joists--Wood beams, usually 2" x 8", which are used to support the floor or ceiling

(NOTE: Refer to local code requirements.)

E. Studs--Wood beams, usually 2" x 4", which are used to support wall materials such as plasterboard, plaster, or paneling

F. Flooring--Consists of a sub-floor (on base) and the finish floor

(NOTE: The finish floor can be made from various materials.)

G. Tradesworkers--People engaged in various trades involved in the construction of buildings and other structures

H. Sketches--Drawings (usually hand drawn) showing all the piping arrangement and information needed to install the piping

I. Journeyman plumber--A plumber who is licensed to design, interpret, and install plumbing systems

J. Plate--Sometimes called the sole plate, this is the base of a studded wall

II. Individuals who could be responsible for determining rough-in locations

A. Employer

B. Customer

(NOTE: The employer or customer gives rough-in locations by verbal orders, sketches, or by marking-out locations.)

C. Journeyman plumber

(NOTE: The journeyman plumber determines locations from scale measurements of blueprints or from manufacturer's specifications.)

III. Factors concerning verbal orders

A. Verbal orders should be clearly understood by both parties

B. Notes should be kept by the plumber with dates and specific information written clearly

C. Verbal orders from unfamiliar people should be verified from the employer or immediate superior

D. Change orders must be verified and signed by the employer or immediate superior

E. Verbal orders should be acknowledged

(NOTE: It is best to repeat verbal orders to make it clear to all parties that the order is understood.)

F. Persons giving verbal orders should be respected for their position

(NOTE: Employers and customers have the right to change their mind; they should receive courteous responses from the worker.)

IV. Factors concerning sketches

A. Sketches are prepared by employer, foreman, customer, and/or the worker

B. Sketches should be discussed by the worker and the person making the sketch

(NOTE: Do not wait until you get to the job site before wondering what is meant by some part of the sketch.)

C. Sketches should be kept in a safe place by the worker until the job is approved

(NOTE: Losing the sketch may result in being unable to defend why you did the job in such a manner.)

D. The worker in charge of an installation should be able to prepare or revise a sketch of the project

E. The sketch should show all the information necessary to understand the job

INFORMATION SHEET

V. Factors concerning marking-out locations

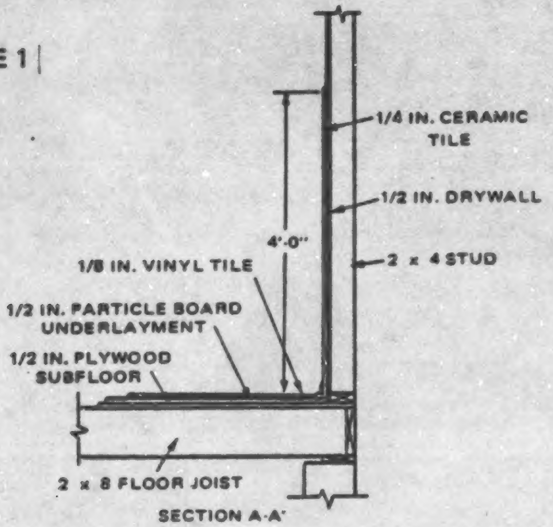
A. Usually the journeyman plumber measures and marks out the locations using the rough-in book, but this can be done in some instances by the employer or customer

(NOTE: Customers should be immediately notified of any problems which will be caused by their calculations.)

B. Sufficient knowledge of construction methods must be learned by the plumber (Figure 1)

1. Terminology of the construction trade
2. Methods of construction
3. Materials for construction

FIGURE 1



1/4 IN. CERAMIC TILE
1/2 IN. DRYWALL
4'-0"
2 x 4 STUD
1/8 IN. VINYL TILE
1/2 IN. PARTICLE BOARD UNDERLAYMENT
1/2 IN. PLYWOOD SUBFLOOR
2 x 8 FLOOR JOIST
SECTION A-A'

C. Considerations in marking locations for holes and openings should include:

1. Plasterboard nails and other nailings
2. Floor or ceiling joist locations

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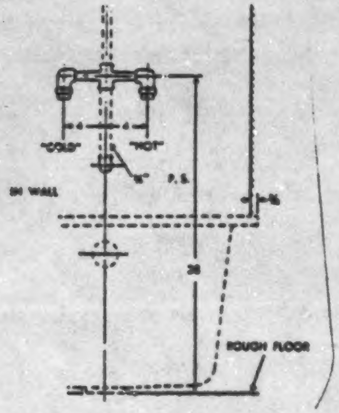
INFORMATION SHEET

3. Stud locations

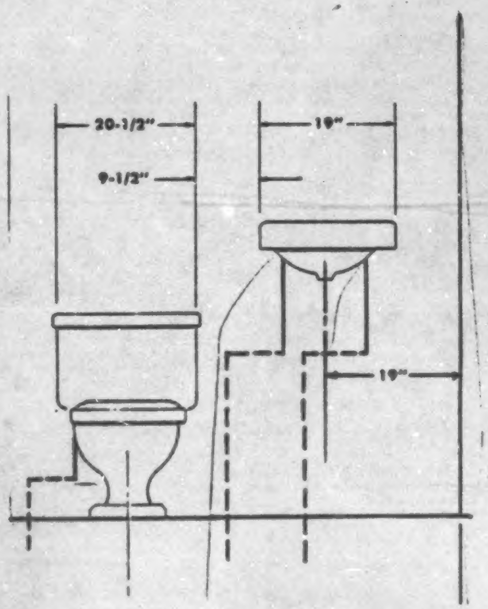
(NOTE: Lavatory, sink, and water closet distribution pipes can be offset (left or right) an inch or more but shower valves must be perfectly centered. See Figure 2.)

FIGURE 2



4. Holes for water pipes through the floor need not be in perfect position (Figure 3)

FIGURE 3

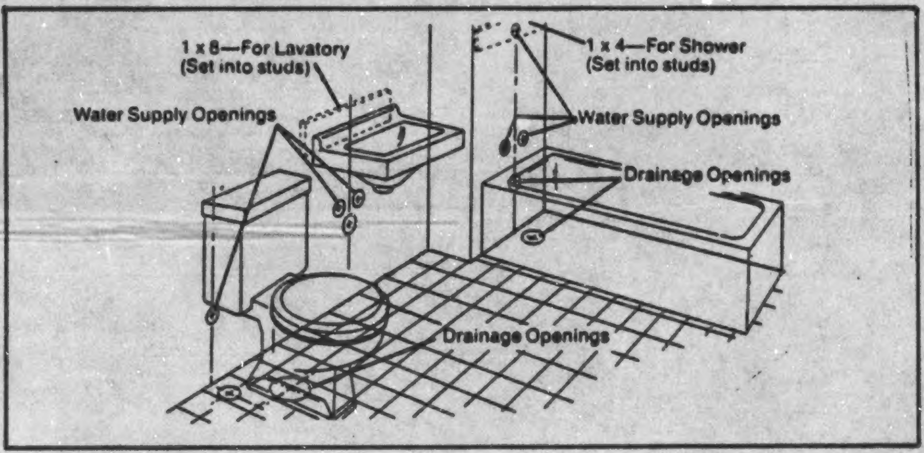


(NOTE: The dotted lines indicate the positioning of pipes inside a wall in order to avoid going through or moving a beam.)

INFORMATION SHEET

5. Holes for water closet, shower, and bathtub drains must be in perfect position (Figure 4)

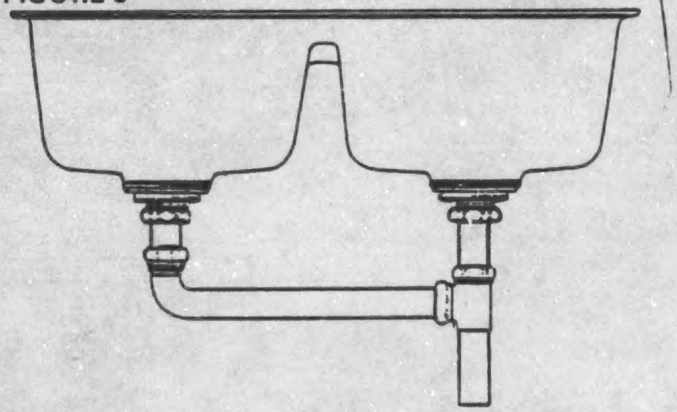
FIGURE 4


1 x 8—For Lavatory
(Set into studs)
Water Supply Openings
1 x 4—For Shower
(Set into studs)
Water Supply Openings
Drainage Openings
Drainage Openings

6. Holes for lavatory and sink drains can be offset an inch or two

(NOTE: Double well kitchen sinks can be offset as much as the distance between well outlets. See Figure 5.)

FIGURE 5

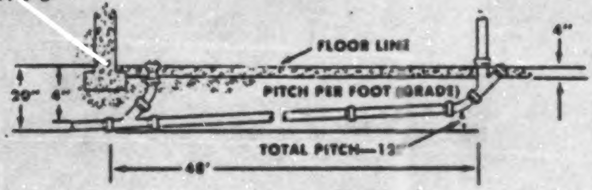


INFORMATION SHEET

7. Concrete slab or basement floor installations are usually done after the initial building foundation has been installed (Figure 6)

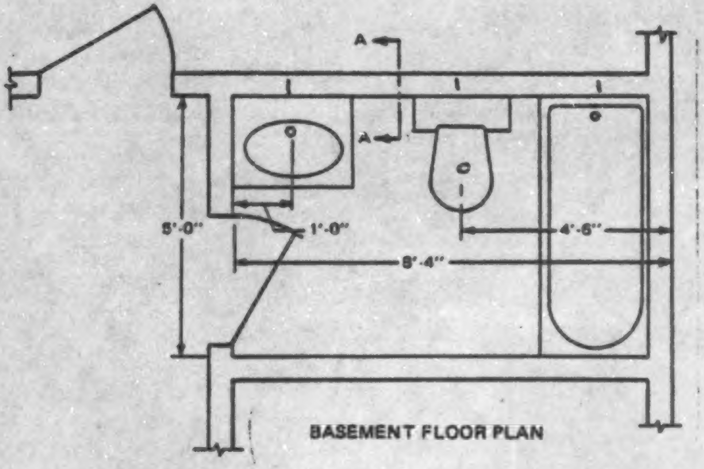
   (NOTE: In many cases, plumbers make provisions for sewer and water access before the footing is poured.)

FIGURE 6


FLOOR LINE
4"
20"
4"
PITCH PER FOOT (GRADE)
TOTAL PITCH—12"
48'

8. Installation of piping in concrete slabs requires accuracy in measurement and pipe joining as an error may necessitate breaking up the floor (Figure 7)

FIGURE 7

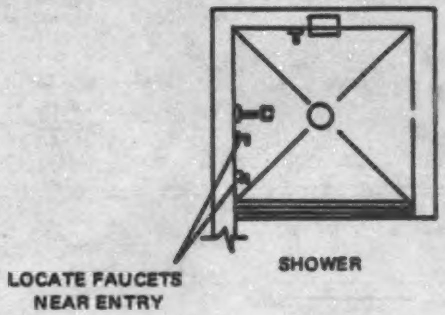

A
A
5'-0"
1'-0"
4'-6"
8'-4"
BASEMENT FLOOR PLAN

INFORMATION SHEET

VI. Information commonly found on manufacturer's specifications (Transparencies 1, 2, and 3)

(NOTE: A manufacturer's handbook or fixture installation sheet should be made available for the rough-in installation. Specifications vary between manufacturers, types, and models of fixtures. The plumber must know which model of fixture is to be installed before rough-in location can be determined. Some fixtures can be flexible in their rough-in locations but others must be exact. See Figure 8.)

FIGURE 8



A. Centerline of drain outlet

B. Centerline of water supply

C. Height of fixture

D. Width of fixture

E. Depth of fixture

F. Height of water supply from rough floor

G. Height of drain outlet from rough floor

H. Rough-in location of rough floor (sub-floor)

I. Rough-in location of rough frame (stud wall)

(NOTE: The finish wall must be taken into consideration. If the finish wall is of unusual thickness, the thickness must be taken into consideration prior to determining pipe locations.)

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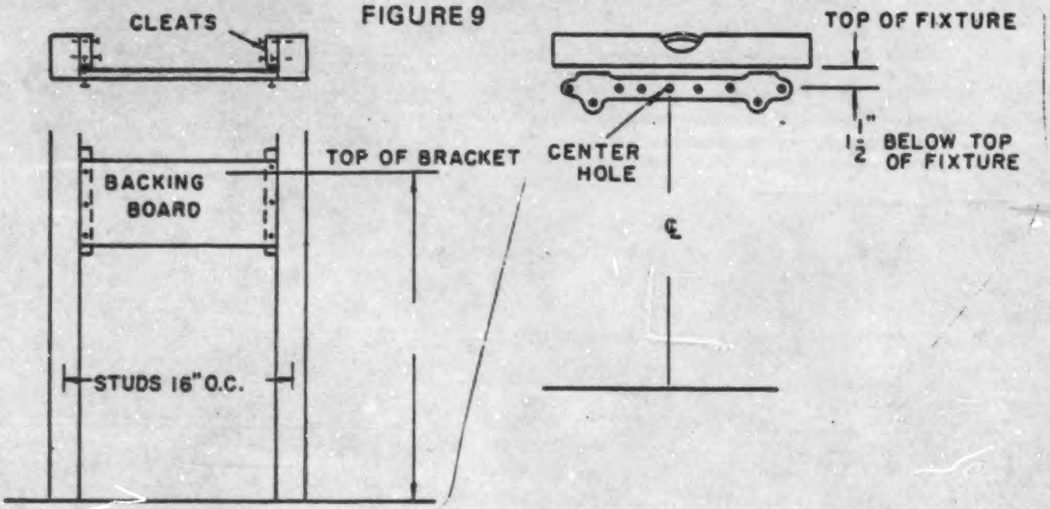
INFORMATION SHEET

VII. Information which can be determined from manufacturer's specifications

A. Location of wall supports (Figure 9)

FIGURE 9


CLEATS
TOP OF BRACKET
BACKING BOARD
STUDS 16" O.C.
TOP OF FIXTURE
CENTER HOLE
1 1/2" BELOW TOP OF FIXTURE
℄

B. Changes in wall structure

(NOTE: Manufacturer's specifications do not indicate piping arrangement. Plumbing codes are the first consideration for determining piping and fitting installation.)

VIII. Tradesworkers in residential construction

A. Masons or bricklayers

B. Carpenters

C. Electricians

D. Plasterboard installers, plasterers

E. Roofers

F. Telephone installers

G. Heating and air-conditioning installers

H. Tile setters

I. Painters

J. Flooring installers

INFORMATION SHEET

IX. Cooperating and coordinating techniques between plumbers and other tradesworkers

A. Respect the codes and regulations of other tradesworkers

B. Give consideration to other tradesworker's work

C. A good employer or supervisor encourages each worker to own and carry his/her own tools and also discourages borrowing

D. Use caution in lending tools to fellow workers

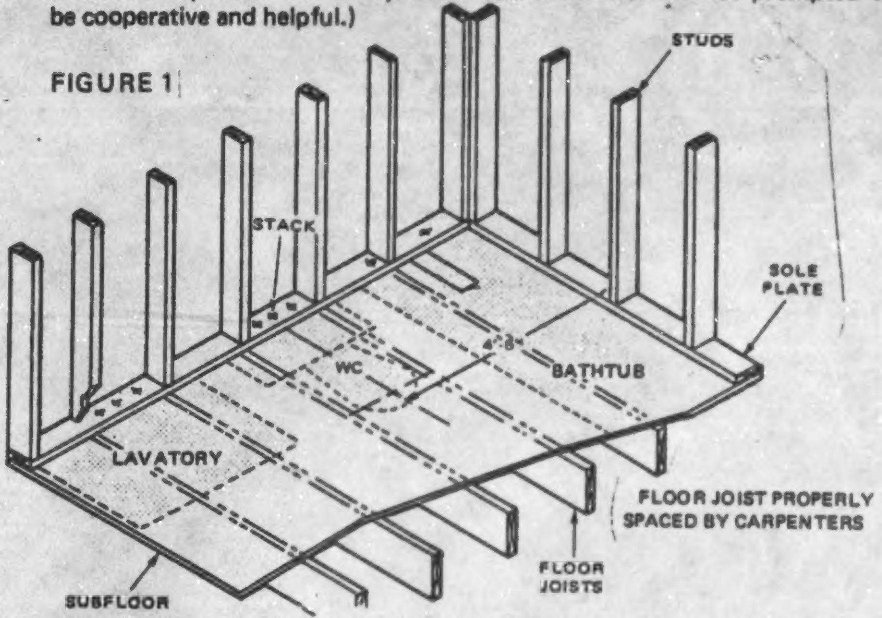
(NOTE: Learn the borrowing habits of your fellow worker before lending tools. Never lend tools to a stranger on the job, but be generous in lending tools to workers who are working in your immediate area because you may need their assistance also.)

E. Do not use the same extension cord as other tradesworkers are using; this can cause inconvenience

F. Have a friendly attitude for other tradesworkers; unfriendly attitudes can cause aggrevation and additional work (Figure 10)

(NOTE: Carpenters can easily cause additional work if not prompted to be cooperative and helpful.)

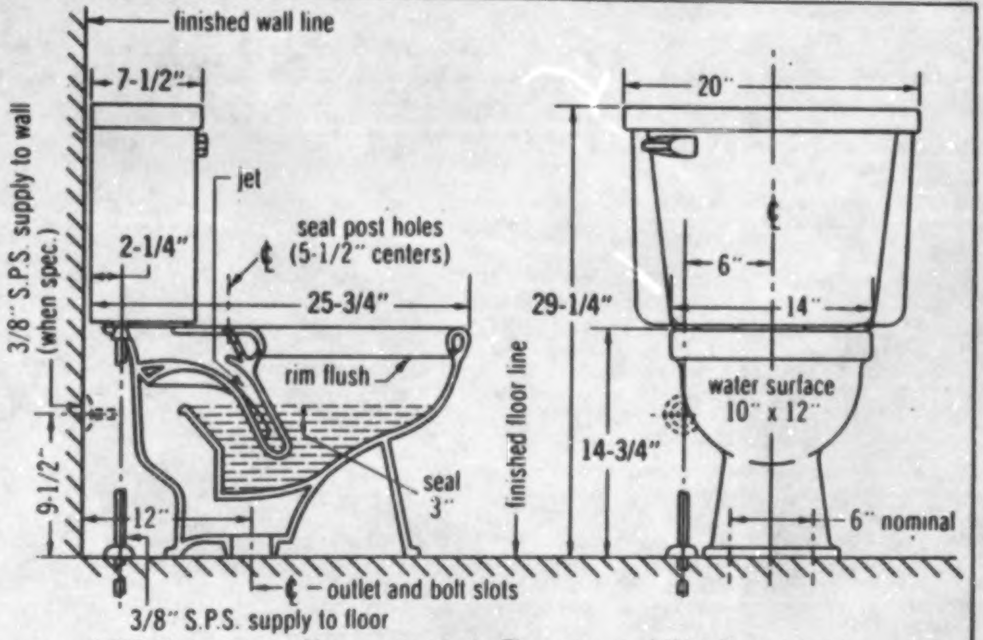
FIGURE 1



FLOOR JOISTS AND STUDS LAYED OUT TO ACCOMMODATE PLUMBING

Manufacturer's Specifications

Water Closet Rough-in Sheet


finished wall line
7-1/2"
jet
2-1/4"
seal post holes
(5-1/2" centers)
℄
25-3/4"
rim flush
3/8" S.P.S. supply to wall
(when spec.)
9-1/2"
12"
seal
3"
finished floor line
℄ – outlet and bolt slots
3/8" S.P.S. supply to floor
20"
℄
6"
14"
29-1/4"
14-3/4"
water surface
10" x 12"
6" nominal

NOTE: above are roughing measurements. They may vary 1/4" (plus or minus).

Mansfield®
PLUMBING PRODUCTS

MANSFIELD SANITARY, INC./PERRYSVILLE, OHIO 44864/PHONE (419) 938-5211 INTERPACE

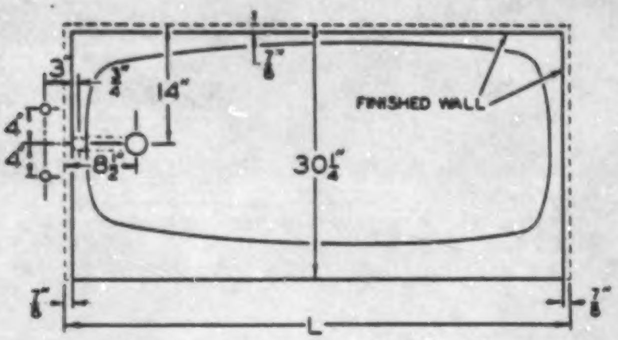
Manufacturer's Specifications

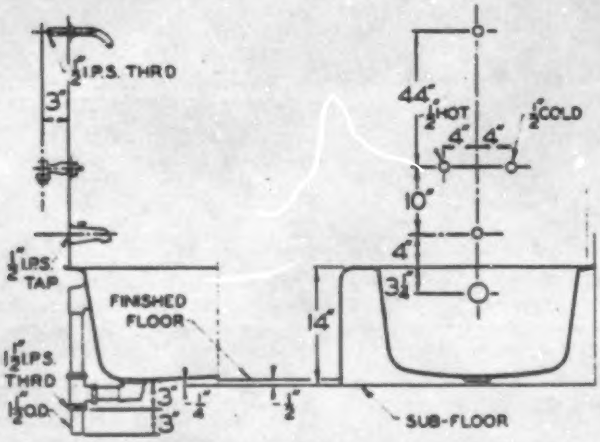
Bathtub Rough-in Sheet

"SEAFORTH" Recess Bath

K-745-S Left outlet.
K-746-S Right outlet.

K-7004-T built-in valve, diverter spout, shower and bath supply.
K-7172-R pop-up drain.


3"
3/4"
14"
7/8"
FINISHED WALL
4"
4"
8 1/2"
30 1/4"
7/8"
L
7/8"


1/2 I.P.S. THRD
3"
1/2 I.P.S. TAP
FINISHED FLOOR
1 1/2 I.P.S. THRD
1 1/2 O.D.
3"
3"
1/4"
1/2"
44"
1/2 HOT
1/2 COLD
4"
4"
10"
4"
3 1/4"
14"
SUB-FLOOR

Size	4½'	5'
L	54"	60"

No change in measurements if with connected drain and overflow.

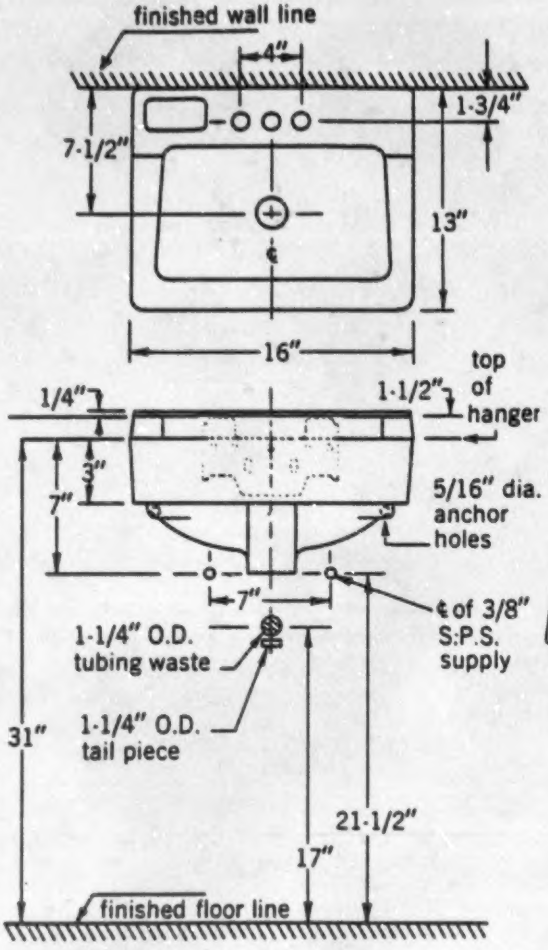
KOHLER | PLUMBING FIXTURES & FITTINGS ENGINEERED FOR EACH OTHER

KOHLER CO KOHLER, WISCONSIN 53044

Measurements may vary ½".

Manufacturer's Specifications

Lavatory Rough-in Sheet


finished wall line
4"
1-3/4"
7-1/2"
13"
℄
16"
top of hanger
1/4"
1-1/2"
3"
7"
5/16" dia. anchor holes
7"
℄ of 3/8" S.P.S. supply
1-1/4" O.D. tubing waste
1-1/4" O.D. tail piece
31"
21-1/2"
17"
finished floor line

NOTE: roughing measurements may vary ¼" (plus or minus).

All Mansfield wall mounted lavatories are supplied with this exclusive one-piece steel hanger. Easily installed and adjusted, it contains 7 holes for solid mounting against wall. Eliminates need for legs.

Mansfield®
PLUMBING PRODUCTS

A SUBSIDIARY OF INTERPACE CORPORATION

MANSFIELD SANITARY, INC., PERRYSVILLE, OHIO 44864/PHONE (419) 938-5211

Form No. LC-1024A

ROUGH-IN LOCATIONS
UNIT III

ASSIGNMENT SHEET #1--DETERMINE MEASUREMENTS FROM A MANUFACTURER'S SPECIFICATIONS

1. Determine the distance from:

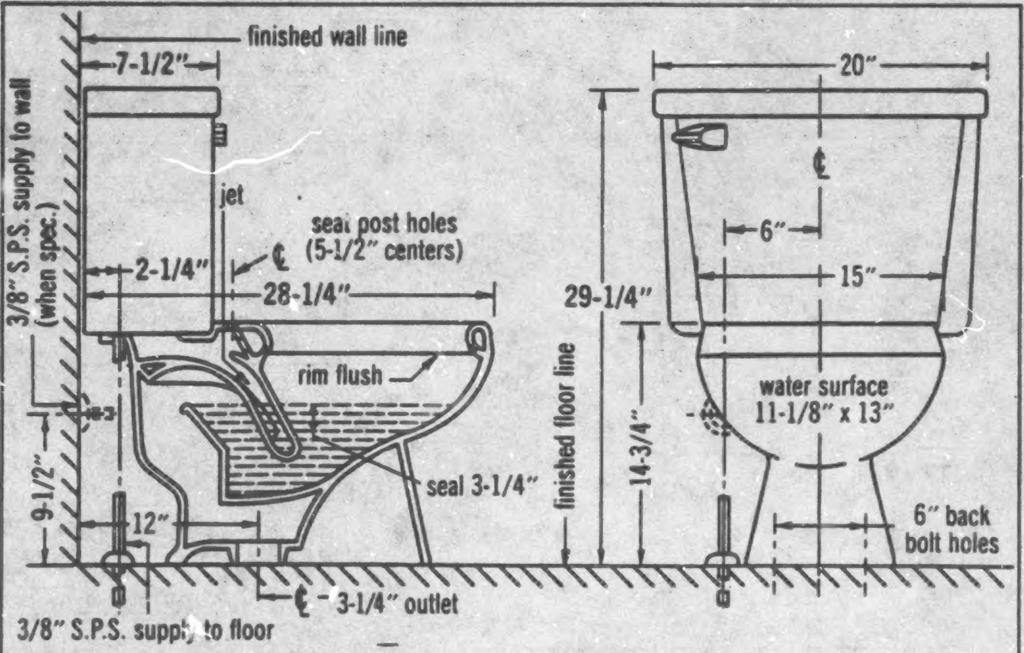
   A. Floor to bowl rim ____________

   B. Floor to tank cover top ____________

   C. Rough wall to center on drain outlet ____________

   D. Floor to cold water stub through wall ____________

   E. Back of water closet to front of water closet ____________


finished wall line
7-1/2"
3/8" S.P.S. supply to wall (when spec.)
jet
seat post holes (5-1/2" centers)
2-1/4"
℄
28-1/4"
rim flush
9-1/2"
12"
seal 3-1/4"
℄ - 3-1/4" outlet
3/8" S.P.S. supply to floor
20"
℄
6"
15"
29-1/4"
finished floor line
14-3/4"
water surface 11-1/8" x 13"
6" back bolt holes

NOTE: above are roughing measurements. They may vary 1/4" (plus or minus).

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MANSFIELD SANITARY, INC./PERRYSVILLE, OHIO 44864/PHONE (419) 938-5211 INTERPACE

ASSIGNMENT SHEET #1

2. Determine the

   a. Width of lavatory ________

   b. Length of lavatory ________

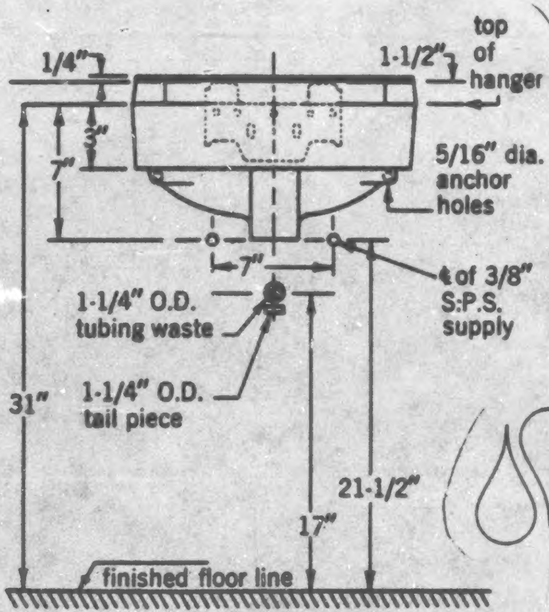
   c. Distance from floor to rim ________

   d. Distance from floor to drain outlet ________

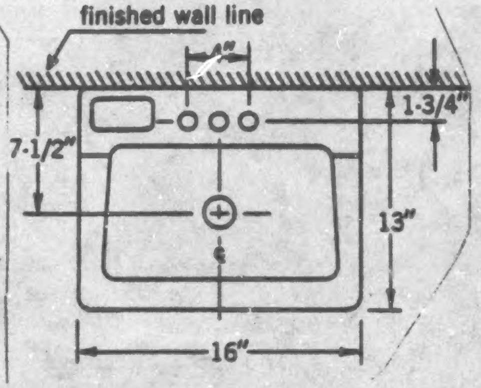
   e. Distance from center-line of hot water to center-line of cold water faucet ________

   f. Distance from wall to drain center ________

   g. Distance from floor to hot and cold water stubs through wall ________


1/4"
1-1/2"
top of hanger
3"
7"
5/16" dia. anchor holes
7"
℄ of 3/8" S.P.S. supply
1-1/4" O.D. tubing waste
1-1/4" O.D. tail piece
31"
21-1/2"
17"
finished floor line

NOTE: roughing measurements may vary ¼" (plus or minus).


finished wall line
4"
1-3/4"
7-1/2"
13"
℄
16"

Mansfield®
PLUMBING PRODUCTS

ASSIGNMENT SHEET #1

3. Determine the:

   a. Width of tub ____________

   b. Length of tub ____________

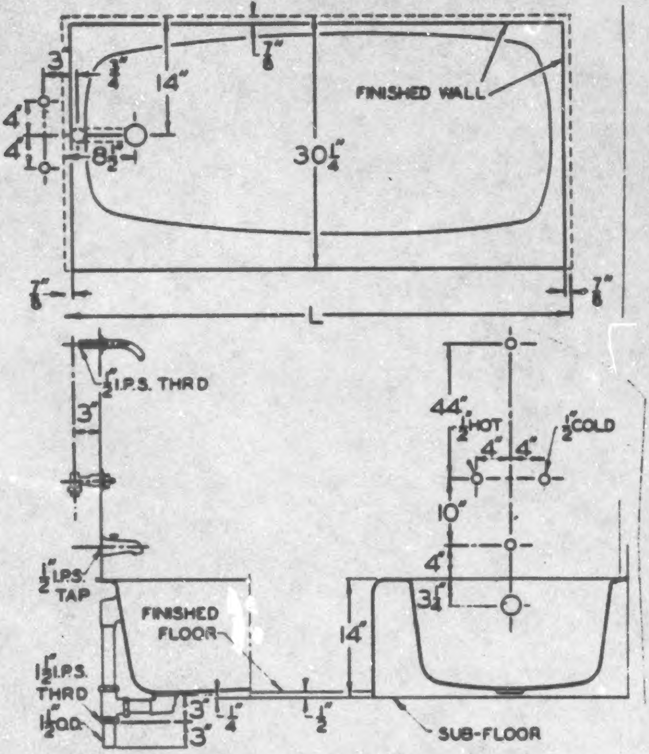
   c. Distance from the rear wall to center-line of tub drain ____________

   d. Distance from the floor to rim of tub ____________

   e. Distance from the floor to center-line of tub spout ____________

   f. Distance from the floor to center-line of shower head ____________

   g. Distance from the endwall to center of waste overflow ____________



3"
3/4"
14"
7/8"
FINISHED WALL
4"
4"
8 1/2"
30 1/4"
7/8"
L
7/8"
1/2" I.P.S. THRD
3"
44"
1/2" HOT
1/2" COLD
4"
4"
10"
4"
1/2" I.P.S. TAP
3 1/4"
FINISHED FLOOR
14"
1 1/2" I.P.S. THRD
1 1/2" O.D.
3"
3"
1/4"
1/2"
SUB-FLOOR

Size	4½'	5'
L	54"	60"

No change in measurements if with connected drain and overflow.

KOHLER | PLUMBING FIXTURES & FITTINGS ENGINEERED FOR EACH OTHER

ROUGH-IN LOCATIONS
UNIT III

ANSWERS TO ASSIGNMENT SHEET #1

1. a. 14 3/4"
   b. 29 1/4"
   c. 12"
   d. 9 1/2"
   e. 28 1/4"
2. a. 13"
   b. 16"
   c. 31"
   d. 17"
   e. 4"
   f. 7 1/2"
   g. 21 1/2"
3. a. 30 1/4"
   b. 60"
   c. 14"
   d. 14"
   e. 18"
   f. 72"
   g. 1 5/8"

ROUGH-IN LOCATIONS
UNIT III

JOB SHEET #1--DETERMINE ROUGH-IN LOCATIONS FOR A BATHROOM

EVALUATION--Given access to tools and equipment, determine rough-in locations for a bathroom. Finished work must be approved by the instructor using the manufacturer's specifications as a check sheet. All items must be correct for satisfactory performance.

I. Tools and materials

   A. Six foot folding rule/steel tape

   B. Pencil--preferably a carpenter's pencil

   C. Manufacturer's specifications (rough-in book) tub, lavatory, water closet (Transparencies 1, 2, and 3)

II. Procedures

   (NOTE: Make drawing full size on concrete floor.)

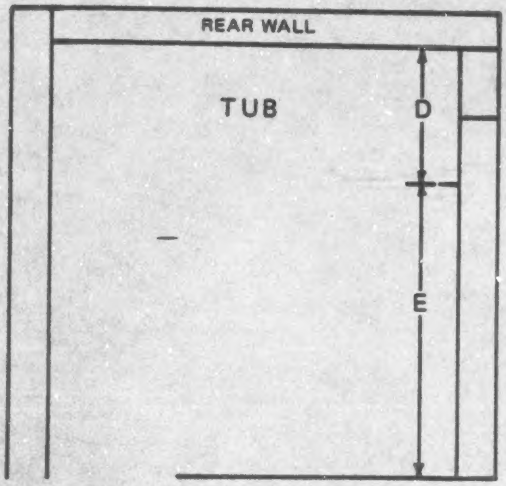
   A. Determine approximate fixture locations

   B. Study the specifications

   C. Measure the room (inside dimensions)

   D. Mark the width of the tub on the floor (Figure 1)

FIGURE 1

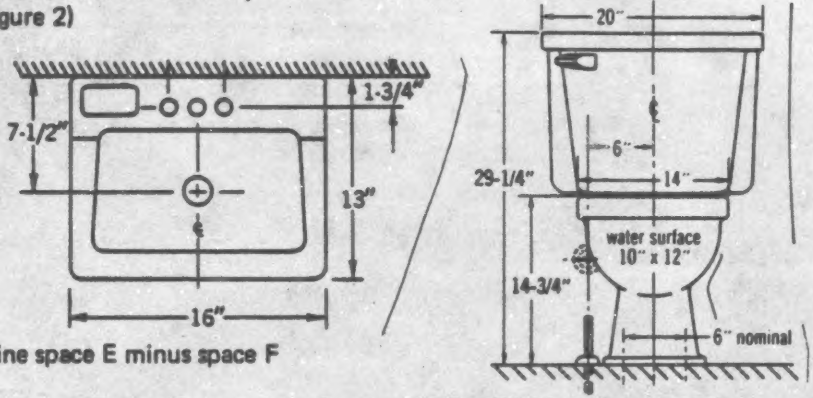


P-141-C

E. Determine the remaining distance to the far wall (Figure 1)

F. Determine combined lavatory and water closet widths to the nearest inch (Figure 2)

FIGURE 2


1-3/4"
7-1/2"
13"
16"
20"
6"
14"
29-1/4"
water surface 10" x 12"
14-3/4"
6" nominal

G. Determine space E minus space F

(NOTE: E = Distance from tub to front wall. F = Width of lavatory plus width of water closet.)

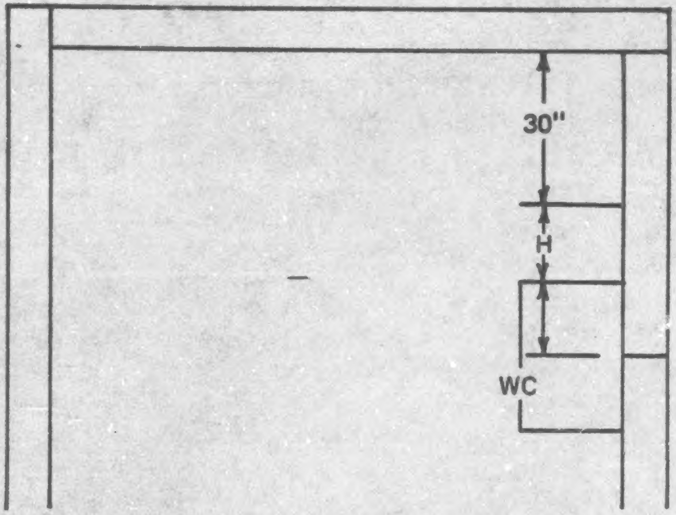
H. Divide space G into three equal spaces

(NOTE: H = 1/3G.)

I. From the rear wall, measure D (the width of the tub) plus H, plus 1/2 the width of the water closet (Figure 3)

(NOTE: Check the specifications. This mark should be 12" off the side wall.)

FIGURE 3



JOB SHEET #1

J. From the front wall, measure H, plus 1/2 the width of the lavatory (Figure 4)

(NOTE: This mark should be made on the wall plate.)

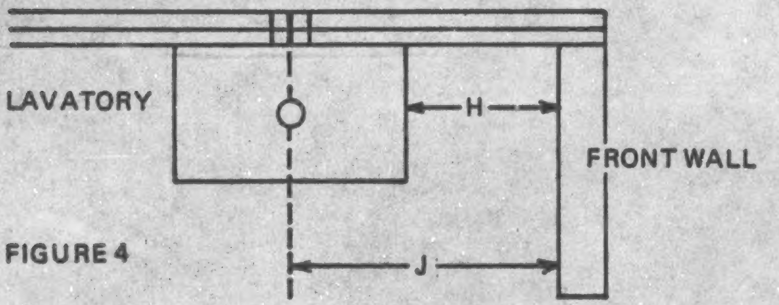


FIGURE 4

K. Mark I and J on the wall plate making a line from one edge to the other

L. Measure from each side of the lavatory drain mark and draw lines for the water risers

(NOTE: Check specifications for measurements.)

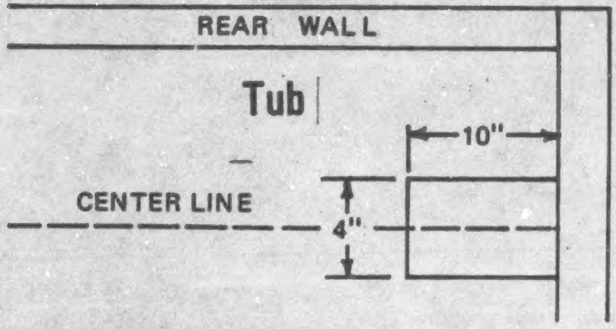
M. Mark the water closet riser

(NOTE: Check specifications for measurement.)

N. Determine center-line of tub drain and mark plate

O. Mark tub drain cut-out on floor--4" wide, 10" long, on center-line of drain (Figure 5)

FIGURE 5



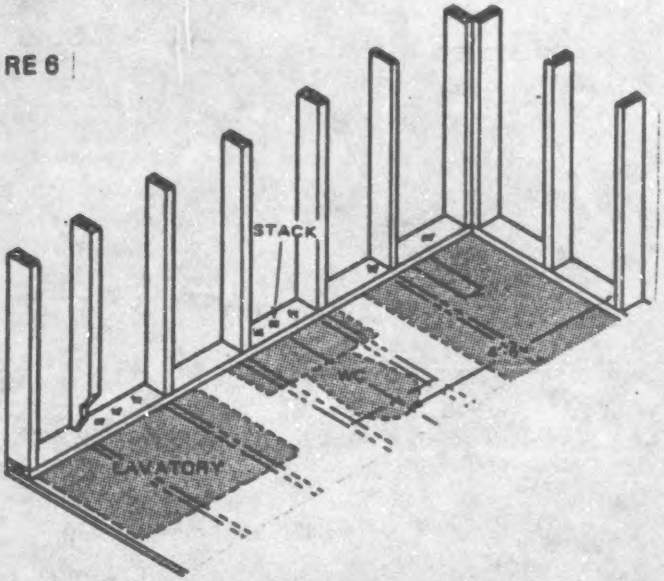
P. Measure from each side of the tub drain mark on the plate and mark out for the water line

JOB SHEET #1

(NOTE: If carpenters have not provided proper stud spacing, a stud may have to be moved.)

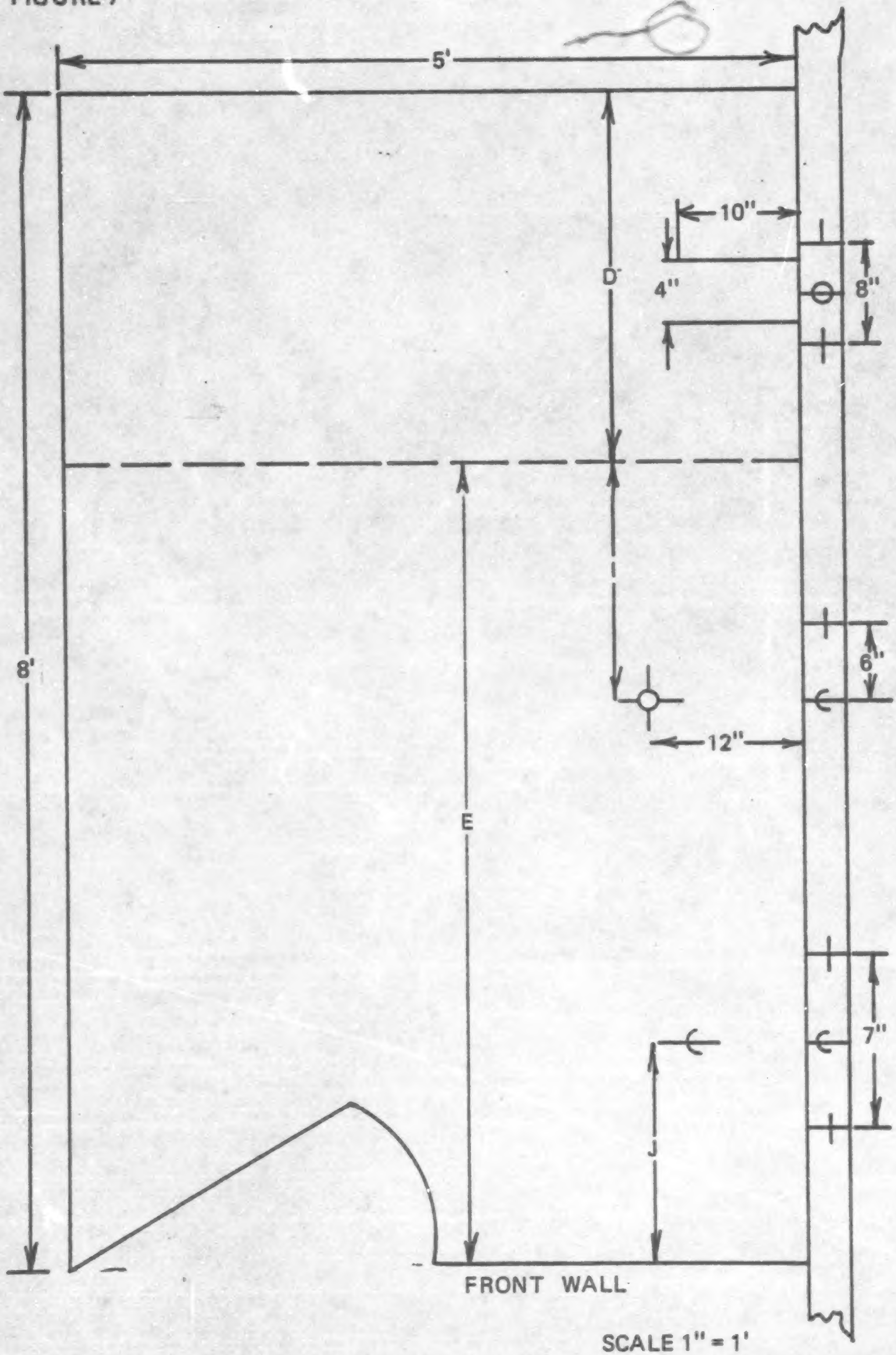
Q. Center all markings on plate and draw a line (Figure 6)

FIGURE 6



(NOTE: The finished project should coincide with Figure 7. There are many alternatives to this project. The lavatory drain could be taken from stack above this floor, all water piping could be taken from two 3/4" risers, or the spacing could be optional.)

FIGURE 7


5'
10"
D
4"
8"
8'
6"
12"
E
7"
J
FRONT WALL

SCALE 1" = 1'

P-145-1

ROUGH-IN LOCATIONS
UNIT III

JOB SHEET #2–ESTABLISH GRADE LINES FOR INSTALLING PLUMBING

EVALUATION: Using form work for a concrete slab and construction plans, establish grade lines and partition walls for installing building drain and water supply lines. Grade lines must be in accordance with local codes and partitions correctly located.

I. Tools and equipment

  A. 100' tape

  B. Blueprint

  C. Nylon string

  D. Wooden stakes

II. Procedure

  A. Check form work length and width for square, using a 100' tape

  B. Locate plumbing walls, using a blueprint

  C. Stretch nylon string at points where plumbing will be installed

  D. Review established grade lines with contractor

ROUGH-IN LOCATIONS
UNIT III

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Preparing for and installing those pipes which will be covered by walls, ceilings, floors, and could be exposed in the basement

_____b. Drawings and directions supplied by fixture manufacturers which indicate exact size, shape, and connections necessary to install the fixture

_____c. Concrete poured in a large flat surface which includes the entire house floor

_____d. Wood beams, usually 2" x 8", which are used to support the floor or ceiling

_____e. Wood beams, usually 2" x 4", which are used to support wall materials such as plasterboard, plaster, or paneling

_____f. Consists of a sub-floor (on base) and the finish floor

_____g. People engaged in various trades involved in the construction of buildings and other structures

_____h. Drawings (usually hand drawn) showing all the piping arrangement and information needed to install the piping

_____i. A plumber who is licensed to design, interpret, and install plumbing systems

_____j. Sometimes called the sole plate, this is the base of a studded wall

1. Journeyman plumber
2. Tradesworkers
3. Plate
4. Flooring
5. Manufacturer's specifications
6. Slab construction
7. Studs
8. Sketches
9. Floor and ceiling joists
10. Rough-in

2. Name three individuals who could be responsible for determining rough-in locations.

a.

b.

c.

3. Select factors concerning verbal orders by placing an "X" in the appropriate blanks.

    ______a. Verbal orders should be clearly understood by both parties

    ______b. Notes should be kept by the plumber with dates and specific information written clearly

    ______c. Verbal orders from unfamiliar people should be verified from the person who does the carpentry

    ______d. Change orders must be verified and signed by the employer or immediate superior

    ______e. Verbal orders should not be acknowledged

    ______f. Persons giving verbal orders should be told to mind their own business

4. Select factors concerning sketches by placing an "X" in the appropriate blanks.

    ______a. Sketches are always prepared by the customer

    ______b. Sketches should be discussed by the worker and the person making the sketch

    ______c. Sketches should be kept in a safe place by the worker until the job is approved

    ______d. The worker in charge of an installation should be able to prepare or revise a sketch of the project

    ______e. The sketch should show only part of the information necessary to understand the job

5. Select factors concerning marking-out locations by placing an "X" in the appropriate blanks.

    ______a. Usually the journeyman plumber measures and marks out the locatons using the rough-in book, but this can be done in some instances by the employer or customer

    ______b. Sufficient knowledge of construction methods must be learned by the plumber

    ______c. Considerations in marking locations for holes and openings should include the size of the structure

    ______d. Holes for water pipes through the floor must be in perfect position

    ______e. Holes for water closet, shower, and bathtub drains must be in perfect position

    ______f. Holes for lavatory and sink drains can be offset an inch or two _____g. Concrete slab or basement floor installations are usually done after the initial building foundation has been installed

_____h. Installation of piping in concrete slabs can be estimated

6. Select information commonly found on manufacturer's specifications by placing an "X" in the appropriate blanks.

_____a. Centerline of drain outlet

_____b. Centerline of water supply

_____c. Height of fixture

_____d. Width of fixture

_____e. Depth of fixture

_____f. Height of water supply from ceiling

_____g. Height of drain outlet from rough floor

_____h. Rough-in location of rough floor (sub-floor)

_____i. Rough-in location of rough frame (stud wall)

7. List two pieces of information which can be determined from manufacturer's specifications.

a.

b.

8. List seven tradesworkers other than plumbers who work in residential construction.

a.

b.

c.

d.

e.

f.

g.

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9. Discuss cooperating and coordinating techniques between plumbers and other tradesworkers.

10. Demonstrate the ability to:

    a. Determine measurements from manufacturer's specifications.

    b. Determine rough-in locations for a bathroom.

    c. Establish grade lines for installing plumbing.

    (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

ROUGH-IN LOCATIONS
UNIT III

ANSWERS TO TEST

1. a. 10
   b. 5
   c. 6
   d. 9
   e. 7
   f. 4
   g. 2
   h. 8
   i. 1
   j. 3
2. a. Employer
   b. Customer
   c. Journeyman plumber
3. a, b, d
4. b, c, d
5. a, b, e, f, g
6. a, b, c, d, e, g, h, i
7. a. Location of wall supports
   b. Changes in wall structure
8. Any seven of the following:
   a. Masons or bricklayers
   b. Carpenters
   c. Electricians
   d. Plasterboard installers, plasterers
   e. Roofers
   f. Telephone installers
   g. Heating and air-conditioning installers
   h. Tile setters
   i. Painters
   j. Flooring installers

9. Discussion should include:

    a. Respect the codes and regulations of other tradesworkers

    b. Give consideration to other tradesworker's work

    c. A good employer or supervisor encourages each worker to own and carry his/her own tools and also discourages borrowing

    d. Use caution in lending tools to fellow workers

    e. Do not use the same extension cord as other tradesworkers are using; this can cause inconvenience

    f. Have a friendly attitude for other tradesworkers; unfriendly attitudes can cause aggrevation and additional work

10. Performance skills evaluated to the satisfaction of the instructor

BUILDING AND PLUMBING CODES
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to discuss the benefits of having a plumbing code, who establishes the code, differences in codes, and regulations concerning the enforcement of codes, and demonstrate the ability to apply code regulations to a plumbing installation. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit the student should be able to:

1. Match terms associated with plumbing codes to the correct definitions or descriptions.
2. Discuss the membership of a plumbing code governing board, its authority and duties.
3. Describe the benefits of zoning laws, building codes, and plumbing codes.
4. Select major categories that should be included in a plumbing code.
5. List basic principles of plumbing codes.
6. Select true statements about illegal fittings or installations.
7. Apply code regulations to a plumbing installation.

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BUILDING AND PLUMBING CODES
UNIT IV

SUGGESTED ACTIVITIES

I. Instructor

- A. Provide student with objective sheet.
- B. Provide student with information and assignment sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information and assignment sheets.
- F. Assign the local Plumbing Code Handbook as a required reading.
- G. Invite local plumbing inspector to visit class.
- H. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete assignment sheet.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
    1. TM 1--Plumbing Code Governing Board
    2. TM 2--Zoning Laws
    3. TM 3--Illegal Fittings and Installations
    4. TM 4--Illegal Fittings and Installations (Continued)

5. TM 5--Illegal Fittings and Installations (Continued)

6. TM 6--Illegal Fittings and Installations (Continued)

D. Assignment Sheet #1--Apply Code Regulations to a Plumbing Installation

E. Answers to assignment sheet

F. Test

G. Answers to test

II. References:

A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, IL: Goodheart-Willcox, 1978.

B. Manus, V. *National Plumbing Code Illustrated.* St. Petersburg, FL: Manus Publishing, 1973.

C. *Plumbing Individualized Learning*, Scarboro, Ontario: Ministry of Colleges and Universities, 1978.

BUILDING AND PLUMBING CODES
UNIT IV

INFORMATION SHEET

I. Terms and definitions

   A. Building code--Set of rules governing the quality of construction in a community

   B. Plumbing code--Set of rules governing the quality of plumbing installations

   (NOTE: A plumbing code can be established at either the state or local level.)

   C. Plumbing inspector--Person authorized to inspect and approve or disapprove plumbing installations according to code specifications

   D. Zoning laws--Rules which specify type of construction permitted in certain areas of a city or town

   E. Inspection--Checking to see if the work conforms to the code specifications

   F. National Plumbing Code--Plumbing code adopted in 1955 and generally accepted as a basis for developing state and local plumbing codes through much of the country

   (NOTE: This code is meant only to be a guideline for state and local codes.)

   G. License--Document stating that the holder has passed trade tests and has proven the ability to perform satisfactory work

   H. Board of Health--Local board which generally regulates and enforces the plumbing code

   (NOTE: In some states this is done by the building department.)

II. Plumbing code governing board (Transparency 1)

   A. Membership

      1. Member of the city board of health

      2. Chief plumbing inspector

      3. One or more master plumbers

      4. One or more journeyman plumbers

   (NOTE: Boards may vary in the number of members, professional background of members, and the authority in the administration of the code.)

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B. Administrative authority

  1. State board

  2. Local board

  (NOTE: States vary in the administration of their individual codes, i.e., some states have one state code, other states permit each locality to administer code.)

C. Duties of the board might include:

  1. Develop regulations which apply to local conditions for plumbing installations

  2. Develop amendments to the code on a regular basis

  3. Present the code and/or amendments to the city or town council for adoption into law

  4. Support the plumbing inspectors in their efforts to enforce the code

  5. Issue licenses and permits

  6. Take necessary steps to enforce the code

  (NOTE: This could include a refusal to connect to city sewer or water, and/or prosecution in the courts.)

III. Benefits of zoning laws, building codes, and plumbing codes (Transparency 2)

A. Zoning laws

  1. Regulate size and type of business or industry in specific geographical locations

  2. Separate residential areas from industrial areas

  3. Create business areas which makes shopping more convenient

  4. Keep noisy, unsightly, or dirty industries away from residential areas

  5. Determine minimum building lot sizes and distance between buildings

B. Building codes

1. Determine the quality of construction in a community

2. Protect public health, safety, and quality of life in a community

(NOTE: Building codes vary as to industrial business and residential construction. They are administered by a chief building inspector whose staff studies plans, issue permits, inspects construction, approves or disapproves construction, and maintains records of current construction and past construction.)

C. Plumbing codes

1. Protect the health of the community

2. Regulate all construction whether industrial, business, or residential

3. Permit grievances or complaints by the plumbing contractor to be reviewed by the board of health or the court

(NOTE: Plumbing codes are usually adminstered by the community board of health and are enforceable by court action.)

IV. Major categories of a plumbing code

A. Basic principles upon which the local code is determined

B. Terms and definitions

C. Basic regulations

Examples: Quality of materials and workmanship, pitch of piping, distances between clean-outs

D. Type of materials and sizing

E. Types and quality of joints

F. Types and location of traps and clean-outs

G. Types and quality of fixtures

H. Design of water pipe, drainage and vents

I. Provisions for inspections and testing

INFORMATION SHEET

V. **Basic principles of plumbing codes**

(NOTE: These principles are based on the National Plumbing Code.)

A. All premises intended for human habitation, occupancy, or use shall be provided with a supply of pure and wholesome water, neither connected with unsafe water supplies nor subject to the hazards of backflow or back siphonage

B. Plumbing fixtures, devices, and appurtenances shall be supplied with water in sufficient volume and at pressures adequate to enable them to function satisfactorily and without undue noise under all normal conditions of use. Hot water shall be provided to fixtures which normally require hot water for their proper use

C. Plumbing shall be designed and adjusted to use the minimum quantity of water consistent with proper performance

D. Devices for heating and storing water shall be designed and installed to prevent dangers from explosion through overheating

E. Every building having plumbing fixtures installed and intended for human habitation, occupancy, or use on premises abutting on a street, alley, or easement in which there is a public sewer shall have a connection with the sewer

F. Each family dwelling unit on premises abutting on a sewer or with a private sewage-disposal system shall have at least one water closet and one kitchen-type sink. It is further recommended that a lavatory and bathtub or shower shall be installed to meet the basic requirements of sanitation and personal hygiene. All other structures for human occupancy or use on premises abutting on a sewer or with a private sewage-disposal system shall have adequate sanitary facilities but in no case less than one water closet and one other fixture for cleaning purposes

G. Plumbing fixtures shall be made of smooth nonabsorbent material, shall be free from concealed fouling surfaces, and shall be located in ventilated enclosures

H. The drainage system shall be designed, constructed, and maintained to guard against fouling deposit of solids, and clogging, and with adequate cleanouts so arranged that the pipes may be readily cleaned

I. The piping of the plumbing system shall be of durable material, free from defective workmanship, and so designed and constructed as to give satisfactory service for its reasonable expected life

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INFORMATION SHEET

J. Each fixture directly connected to the drainage system shall be equipped with a water-seal trap

K. The drainage system shall be designed to provide an adequate circulation of air in all pipes with no danger of siphonage, aspiration, or forcing of trap seals under conditions of ordinary use

L. Each vent terminal shall extend to the outer air and be installed to minimize the possibilities of clogging and the return of foul air to the building

M. The plumbing system shall be subjected to such tests as will effectively disclose all leaks and defects in the work

N. No substance which will clog the pipes, produce explosive mixtures, destroy the pipes or their joints, or interfere unduly with the sewage-disposal process shall be allowed to enter the building drainage system

O. Proper protection shall be provided to prevent contamination of food, water, sterile goods, and similar materials by backflow of sewage. When necessary, the fixture, device, or appliance shall be connected indirectly with the building drainage system

P. No water closet shall be located in a room or compartment which is not properly lighted and ventilated

Q. If water closets or other plumbing fixtures are installed in buildings where there is no sewer within a reasonable distance, suitable provision shall be made for disposing of the building sewage by some accepted method of sewage treatment and disposal

R. Where a plumbing drainage system may be subjected to backflow of sewage, suitable provision shall be made to prevent its overflow in the building

S. Plumbing systems shall be maintained in a sanitary and serviceable condition. See definition "Plumbing"

T. All plumbing fixtures shall be so installed with regard to spacing as to be reasonably accessible for their intended use

U. Plumbing shall be installed with due regard to preservation of the strength of structural members and prevention of damage to walls and other surfaces through fixture usage

V. Sewage or other waste from a plumbing system which may be deleterious to surface or subsurface waters shall not be discharged into the ground or into any waterway unless it has first been rendered innocuous through subjection to some acceptable form of treatment

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INFORMATION SHEET

VI. Illegal fittings and installations

A. A sanitary tee fitting should not be used to change the direction of flow of horizontal drainage piping

B. A sanitary tee fitting should not be used to change direction from vertical to horizontal flow of drainage pipe (Transparency 3)

C. A double sanitary tee should not be used if the outlet is the same size as the inlet (Transparency 4)

D. A single or double tee should not be used in either vertical or horizontal drainage piping (Transparency 4)

E. A 90° bend should have a radius not less than the diameter of the pipe (Transparency 5)

F. Connections into the drainage system should be made with approved fittings and not by drilling or tapping (Transparency 5)

G. Double hub caulked fittings and pipes (cast iron) shall not be used except for vent lines (Transparency 5)

H. A sanitary tee fitting in a vertical vent line should be inverted (Transparency 6)

I. Traps should have an accessible clean-out or be able to be disassembled (Transparency 6)

J. Fittings which reduce the flow in a drainage system are not permitted (Transparency 6)

Plumbing Code Governing Board

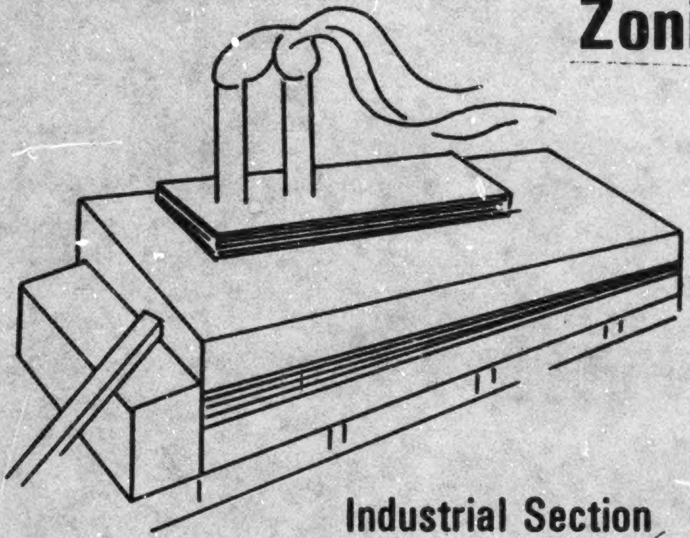
Member of
Board of Health

Chief Plumbing
Inspector

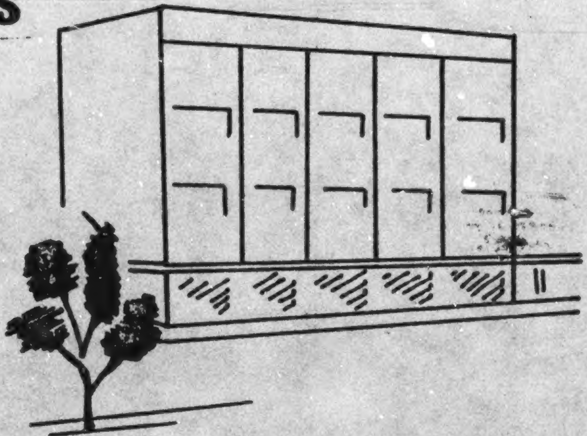
Master Plumber

Journeyman
Plumbers

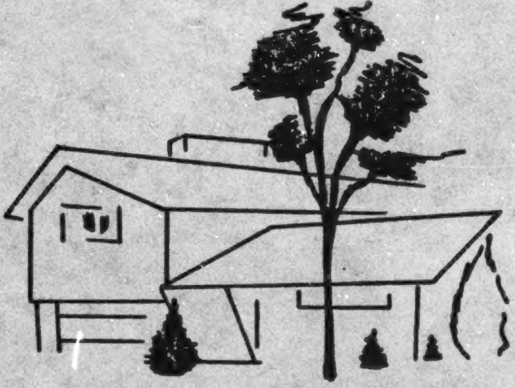
Zoning Laws



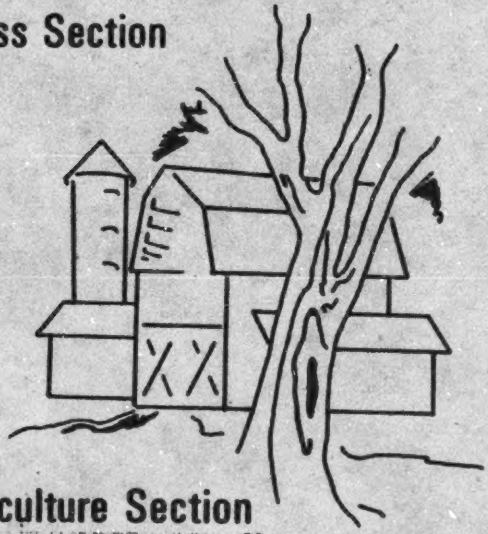
Industrial Section



Business Section



Residential Section



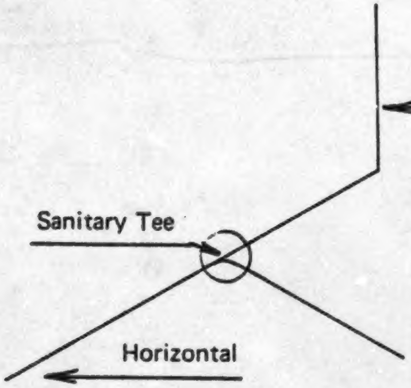
Agriculture Section

Illegal Fittings and Installations

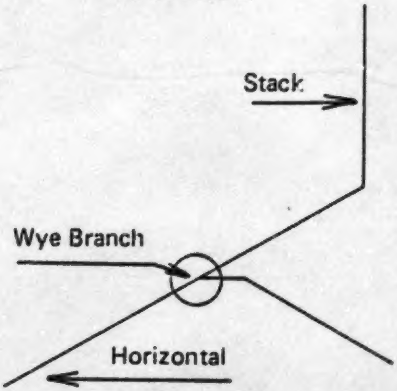
(Note: Check Local Codes)

A.

Incorrect

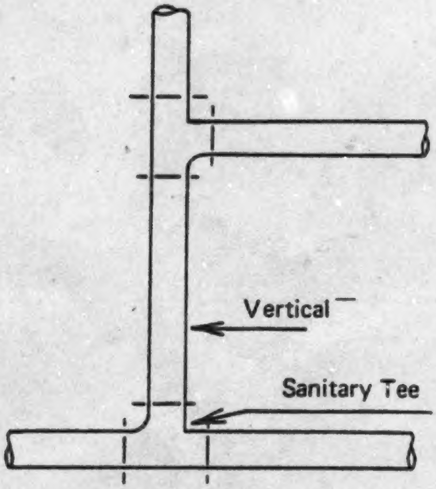

Stack
Sanitary Tee
Horizontal

Correct

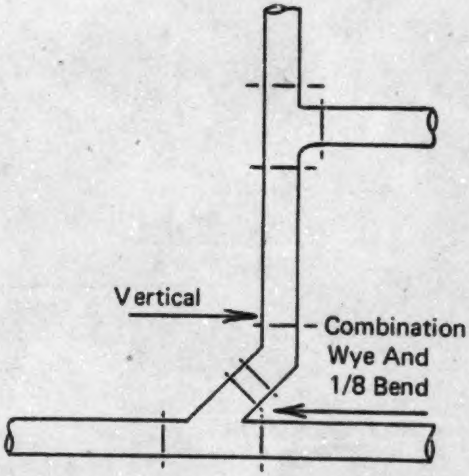

Stack
Wye Branch
Horizontal

B.

Incorrect


Vertical
Sanitary Tee

Correct


Vertical
Combination Wye And 1/8 Bend

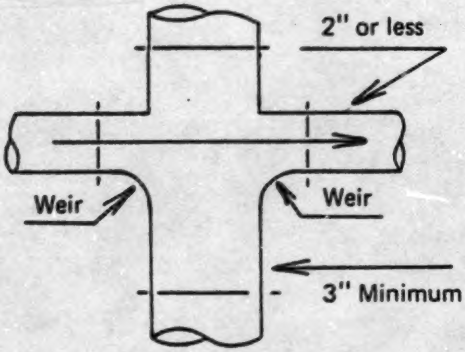
Illegal Fittings and Installations

(Continued)

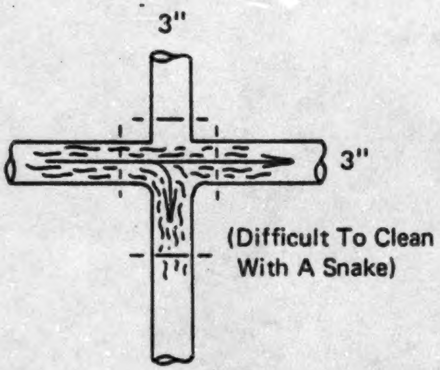
C.

Correct

Double Sanitary Tee

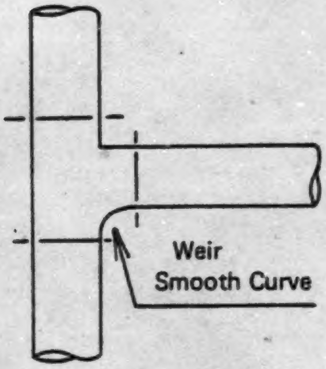

2" or less
Weir
Weir
3" Minimum

Incorrect


3"
3"
(Difficult To Clean
With A Snake)

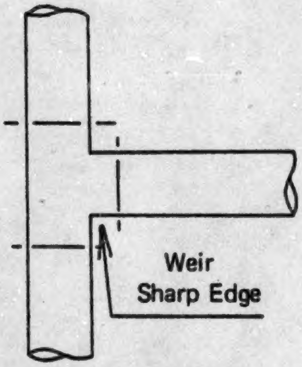
D.

Correct


Weir
Smooth Curve

Sanitary Tee Fitting

Incorrect

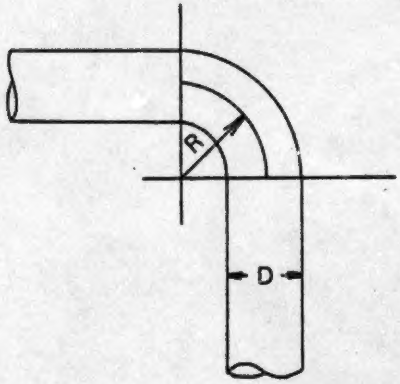

Weir
Sharp Edge

Straight Tee Fitting

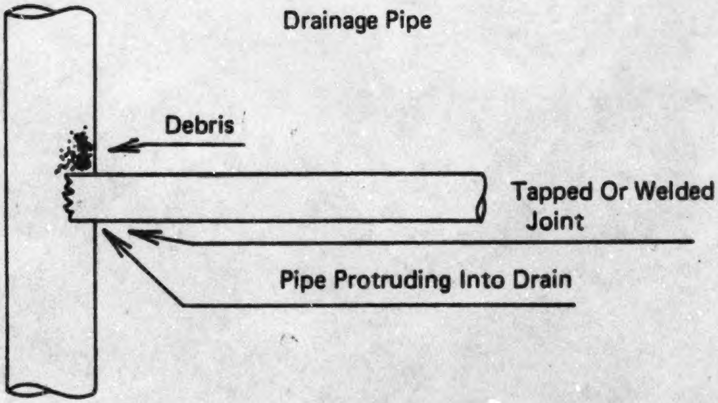
Illegal Fittings and Installations

(Continued)

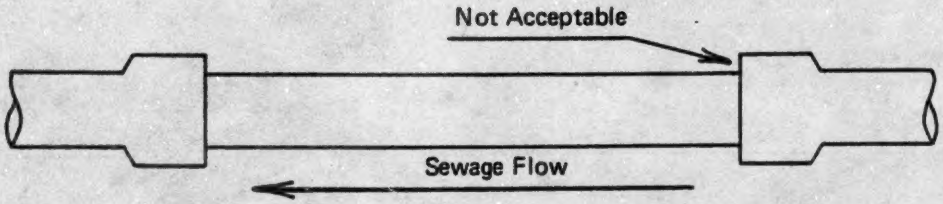
E.



F.


Drainage Pipe
Debris
Tapped Or Welded Joint
Pipe Protruding Into Drain

G.

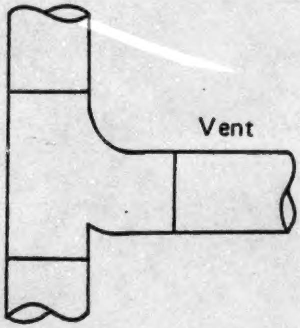

Not Acceptable
Sewage Flow

Illegal Fittings and Installations

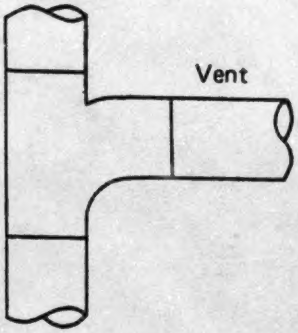
(Continued)

H.

Correct

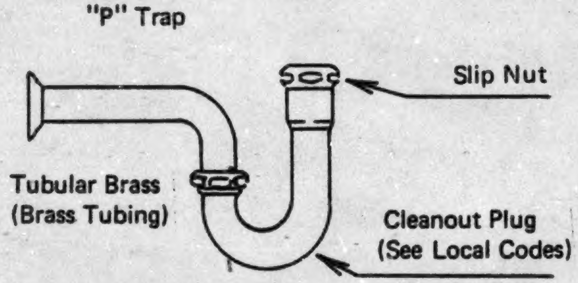


Incorrect

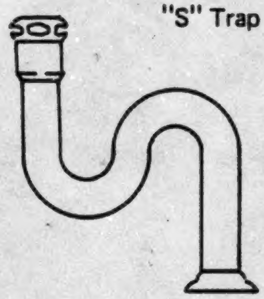


I.

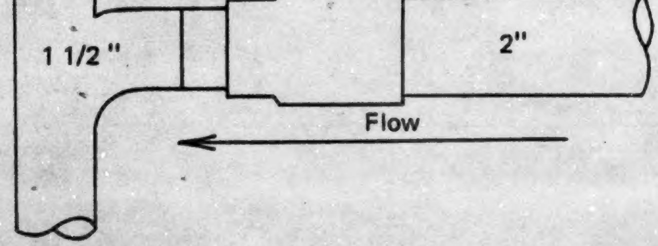
Correct


"P" Trap
Slip Nut
Tubular Brass
(Brass Tubing)
Cleanout Plug
(See Local Codes)

Incorrect



J.



BUILDING AND PLUMBING CODES
UNIT IV

ASSIGNMENT SHEET #1–APPLY CODE REGULATIONS TO A PLUMBING INSTALLATION

Directions: Using either a state or local plumbing code book list the type and size of fitting identified by letter on the following drawing.

A.

B.

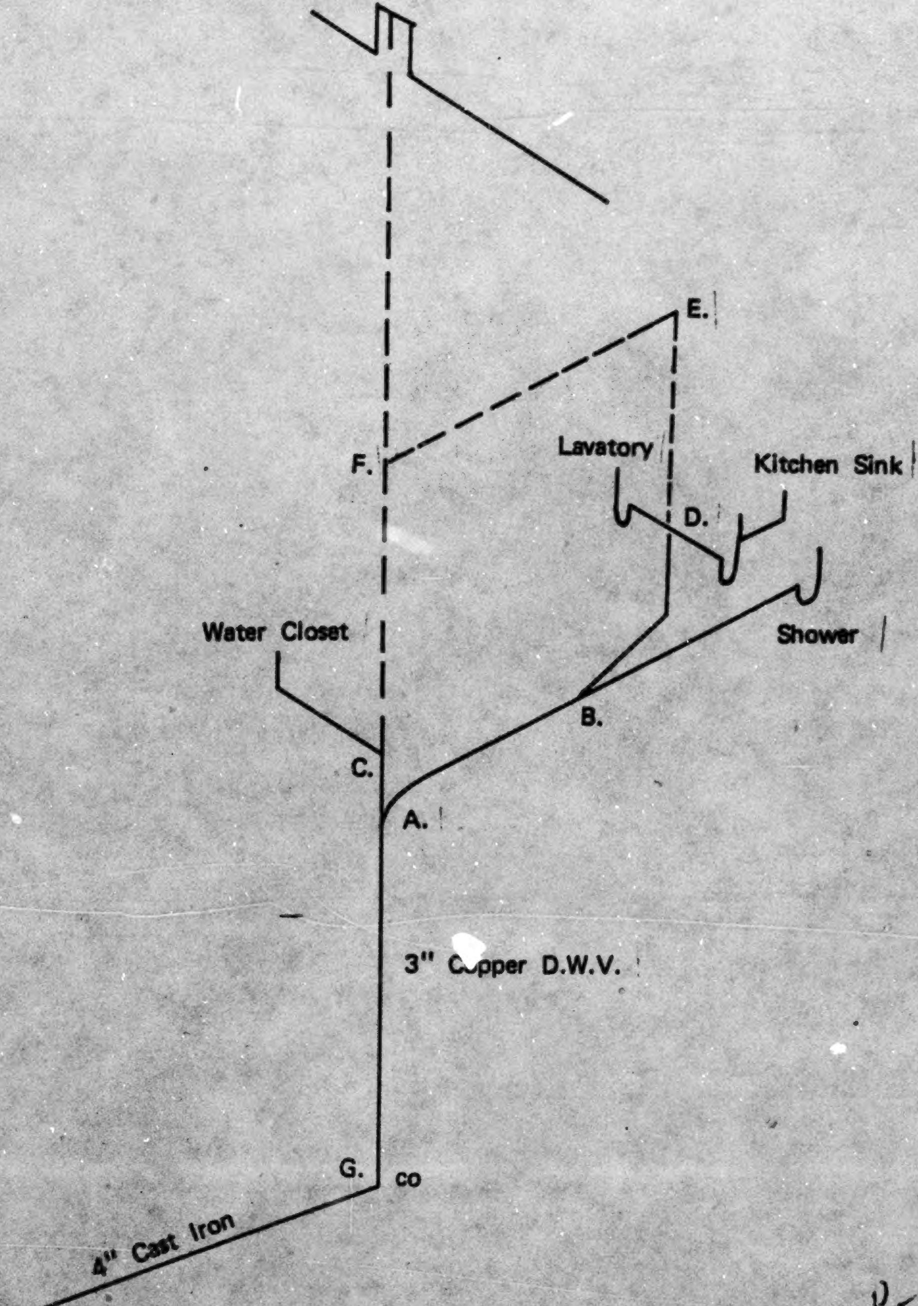
C.

D.

E.

F.

G.


E.
Lavatory
Kitchen Sink
D.
Shower
F.
Water Closet
B.
C.
A.
3" Copper D.W.V.
G.
CO
4" Cast Iron

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BUILDING AND PLUMBING CODES
UNIT IV

ANSWERS TO ASSIGNMENT SHEET #1

A. 3" x 2" sanitary tee

B. 2" Y

C. 3" sanitary tee

D. 2" x 1 1/2" Double sanitary tee

E. 2" 90° EL

F. 3" x 2" sanitary tee

G. 4" C.I. Y and 1/8th bend

BUILDING AND PLUMBING CODES
UNIT IV

NAME ______________________________

TEST

1. Match terms on the right to the correct definitions or descriptions.

_____a. Set of rules governing the quality of construction in a community

_____b. Set of rules governing the quality of plumbing installations

_____c. Person authorized to inspect and approve or disapprove plumbing installations according to code specifications

_____d. Rules which specify type of construction permitted in certain areas of a city or town

_____e. Checking to see if the work conforms to the code specifications

_____f. Plumbing code adopted in 1955 and generally accepted as a basis for developing state and local codes through much of the country

_____g. Document stating that the holder has passed trade tasts and has proven ability to perform satisfactory work

_____h. Local board which generally regulates and enforces the plumbing code

1. Plumbing code
2. Zoning laws
3. Inspection
4. License
5. Plumbing inspector
6. Board of Health
7. Building code
8. National Plumbing Code

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2. Discuss the membership of a plumbing code governing board, its authority and duties.

3. Describe the benefits of zoning laws, building codes, and plumbing codes.

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4. Select major categories that should be included in a plumbing code by placing an "X" in the appropriate blanks.

______a. Terms and definitions

______b. Design of water pipe, drainage, and vents

______c. Seasonal recommendations

______d. Types and quality of fixtures

______e. Plumbing legal issues

______f. Basic regulations

______g. Types and quality of joints

5. List ten basic principles of plumbing codes.

a.

b.

c.

d.

e.

f.

g.

h.

i.

j.

6. Select the true statements about illegal fittings or installations by placing an "X" to the left of those statements which are true.

______a. A sanitary tee fitting should not be used to change direction from vertical to horizontal flow of drainage pipe

______b. A single or double tee should be used in either vertical or horizontal drainage piping

______c. A 90° bend should always have a radius of less than the diameter of the pipe

______d. Double hub caulked fittings and pipes shall not be used except for vent lines

______e. Fittings which reduce the flow in a drainage system are permitted ______f. Traps should have an accessible clean-out or be able to be disassembled

______g. A sanitary tee fitting in a vertical vent line should be inverted

______h. Connections into the drainage system may be made with approved fittings or by drilling or tapping

______i. A double sanitary tee should not be used if the outlet is the same size as the inlet

______j. A sanitary tee fitting should not be used to change the direction of flow of horizontal drainage piping

7. Apply code regulations to a plumbing installation.

(NOTE: If this activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

BUILDING AND PLUMBING CODES
UNIT IV

ANSWERS TO TEST

1. a. 7
   b. 1
   c. 5
   d. 2
   e. 3
   f. 8
   g. 4
   h. 6

2. Discussion should include:

   a. Membership

      1) Member of the city board of health

      2) Chief plumbing inspector

      3) One or more master plumbers

      4) One or more journeyman plumbers

   b. Administrative authority

      1) State board

      2) Local board

   c. Duties of the board

      1) Develop regulations which apply to local conditions for plumbing installations

      2) Develop amendments to the code on a regular basis

      3) Present the code and/or amendments to the city or town council for adoption into law

      4) Support the plumbing inspectors in their efforts to enforce the code

      5) Issue licenses and permits

      6) Take necessary steps to enforce the code

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3. Description should include

   a. Zoning laws

      1) Regulate size and type of business or industry in specific geographical locations

      2) Separate residential areas from industrial areas

      3) Create business areas which makes shopping more convenient

      4) Keep noisy, unsightly, or dirty industries away from residential areas

      5) Determine minimum building lot sizes and distance between buildings

   b. Building codes

      1) Determine the quality of construction in a community

      2) Protect public health, safety, and quality of life in a community

   c. Plumbing codes

      1) Protect the health of the community

      2) Regulate all construction whether industrial, business, or residential

      3) Permit grievances or complaints by the plumbing contractor to be reviewed by the board of health or the court

4. a, b, d, f, g

5. Any ten of the following:

   a. All premises intended for human habitation, occupancy, or use shall be provided with a supply of pure and wholesome water, neither connected with unsafe water supplies nor subject to the hazards of backflow or back siphonage

   b. Plumbing fixtures, devices, and appurtenances shall be supplied with water in sufficient volume and at pressures adequate to enable them to function satisfactorily and without undue noise under all normal conditions of use. Hot water shall be provided to fixtures which normally require hot water for their proper use

   c. Plumbing shall be designed and adjusted to use the minimum quantity of water consistent with proper performance

   d. Devices for heating and storing water shall be designed and installed to prevent dangers from explosion through overheating

   e. Every building having plumbing fixtures installed and intended for human habitation, occupancy, or use on premises abutting on a street, alley, or easement in which there is a public sewer shall have a connection with the sewer

f. Each family dewlling unit on premises abutting on a sewer or with a private sewage-disposal system shall have at least one water closet and one kitchen-type sink. It is further recommended that a lavatory and bathtub or shower shall be installed to meet the basic requirements of sanitation and personal hygiene. All other structures for human occupancy or use on premises abutting on a sewer or with a private sewage-disposal system shall have adequate sanitary facilities but in no case less than one water closet and one other fixture for cleaning purposes

g. Plumbing fixtures shall be made of smooth nonabsorbent material, shall be free from concealed fouling surfaces, and shall be located in ventilated enclosures

h. The drainage system shall be designed, constructed, and maintained to guard against fouling deposit of solids, and clogging, and with adequate cleanouts so arranged that the pipes may be readily cleaned

i. The piping of the plumbing system shall be of durable material, free from defective workmanship, and so designed and constructed as to give satisfactory service for its reasonable expected life

j. Each fixture directly connected to the drainage system shall be equipped with a water-seal trap

k. The drainage system shall be designed to provide an adequate circulation of air in all pipes with no danger of siphonage, aspiration, or forcing of trap seals under conditions of ordinary use

l. Each vent terminal shall extend to the outer air and be installed to minimize the possibilities of clogging and the return of foul air to the building

m. The plumbing system shall be subjected to such tests as will effectively disclose all leaks and defects in the work

n. No substance which will clog the pipes, produce explosive mixtures, destroy the pipes or their joints, or interfere unduly with the sewage-disposal process shall be allowed to enter the building drainage system

o. Proper protection shall be provided to prevent contamination of food, water, sterile goods, and similar materials by backflow of sewage. When necessary, the fixture, device, or appliance shall be connected indirectly with the building drainage system

p. No water closet shall be located in a room or compartment which is not properly lighted and ventilated

q. If water closets or other plumbing fixtures are installed in buildings where there is no sewer within a reasonable distance, suitable provision shall be made for disposing of the building sewage by some accepted method of sewage treatment and disposal

r. Where a plumbing drainage system may be subjected to backflow of sewage, suitable provision shall be made to prevent its overflow in the building

s. Plumbing systems shall be maintained in a sanitary and serviceable condition. See definition "Plumbing"

t. All plumbing fixtures shall be so installed with regard to spacing as to be reasonably accessible for their intended use

u. Plumbing shall be installed with due regard to preservation of the strength of structural members and prevention of damage to walls and other surfaces through fixture usage

v. Sewage or other waste from a plumbing system which may be deleterious to surface or subsurface waters shall not be discharged into the ground or into any waterway unless it has first been rendered innocuous through subjection to some acceptable form of treatment

6. a, d, f, g, i, j

7. Evaluated to the satisfaction of the instructor

METRIC MEASUREMENT FOR PLUMBERS
UNIT V

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with metric measurement to the correct definitions or descriptions, select true statements representing history of the metric system, and convert English system measurements into metric system measurements. This knowledge will be evidenced by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with metric measurement to the correct definitions or descriptions.
2. Select true statements representing the history of the metric system.
3. Convert approximate pipe sizes and lengths from the English system to the metric system.
4. Convert temperature measurements from the English system to the metric system.
5. Convert liquid measurements from the English system to the metric system.
6. Convert weight (mass) measurements from the English system to the metric system.

I-11-C

METRIC MEASUREMENT FOR PLUMBERS
UNIT V

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information sheet.

   C. Discuss unit and specific objectives.

   D. Discuss information sheet.

   E. Discuss those areas of our society which use metric measurements such as the medical professions and engineering.

   F. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Test

   D. Answers to test

II. Reference--Naval Education and Training Command. *The Metric System.* Washington, D.C.: U.S. Government Printing Office, 1975.

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METRIC MEASUREMENT FOR PLUMBERS
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. English system--System currently used in the United States; measurements are in inches, feet, and yards, and temperature is measured in Fahrenheit degrees

B. Metric system--System used in most of the world; measurements are in millimeters, meters, and kilometers, and temperature is measured in Celsius degrees

C. SI--International System of Units, modern version of the metric system

D. 10th multiple--Referring to the metric system as being divisible into 10 parts

(NOTE: The English system has variable measurements lists: lineal lists 12 inches to the foot; weight lists 16 ounces to the pound; liquid lists 32 ounces to the quart.)

E. Mass--Word adopted by the metric system for weight

F. Lineal--Measurement of lines, length or width

G. Maximum density of water--The point water reaches at 39.2°F

(NOTE: At 39.2°F water has become cool and has contracted to its smallest size. At lower or higher temperatures it will start to expand.)

II. History of the metric system

A. 1670--French astronomer proposed first system based on decimal (10) divisions of the earth's circumference

B. 1790--French Academy of Sciences developed metric system and coined the word meter as the basic unit of lineal measurement

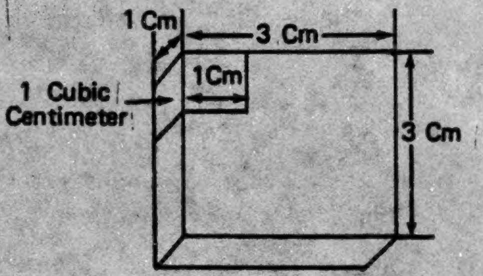
1. The meter was defined as that measurement equal to one ten-millionth of the distance from the North Pole to the equator on a line through France

INFORMATION SHEET

2. The metric unit of mass, called the gram, was defined as one cubic centimeter of water at its temperature of maximum density (Figure 1)

   (NOTE: A cubic centimeter is a cube that is one-hundredth of a meter on each side.)

   FIGURE 1

3. The metric unit of liquid, called the liter, was defined as one cubic decimeter

   (NOTE: A cubic decimeter is a cube one-tenth of a meter on each side.)

C. 1840–France officially adopts the metric system followed by most European countries

D. 1866–United States adopts the metric system through an act of congress

E. 1875–The Treaty of the Metre was established by 17 countries, including the United States, to refine and promote the metric system

F. 1960–International System of Units established to revise and simplify the system

G. 1971–The U.S. Department of Commerce recommended to the congress that the U.S. change to the metric system through a coordinated national program

   (NOTE: The U.S. and four underdeveloped countries are the only nations not using the metric system.)

III. Metric pipe sizes and lengths

(NOTE: All conversions are approximate.)

A. Abbreviations

1. mm = millimeter
2. cm = centimeter
3. m = meter

INFORMATION SHEET

B. Conversions

1. 25mm = 2.5cm = .025m = approximately 1 inch
2. 100mm = 10cm = 0.10m = approximately 4 inches
3. 250mm = 25cm = 0.25m = approximately 10 inches
4. 500mm = 50cm = 0.50m = approximately 20 inches
5. 750mm = 75cm = 0.75m = approximately 29 1/2 inches
6. 900mm = 90cm = 0.90m = approximately 36 inches
7. 1000mm = 100cm = 1.00m = approximately 39 inches

C. Applications--Nominal pipe size

1. 1" diameter pipe = 25mm pipe
   1 1/4" diameter pipe = 32mm pipe
   1 1/2" diameter pipe = 38mm pipe
   2" diameter pipe = 50 mm pipe
   3" diameter pipe = 75mm pipe
   4" diameter pipe = 100mm pipe
2. 10" length = 250mm or 25cm
   20" length = 500mm or 50cm
   100" length = 2500mm or 250cm

IV. Metric temperature measurements

A. Abbreviations

1. C° = Celsius temperature
2. F° = Fahrenheit temperature

B. Conversions--To find C° when you know F°, multiply by 5/9 after subtracting 32

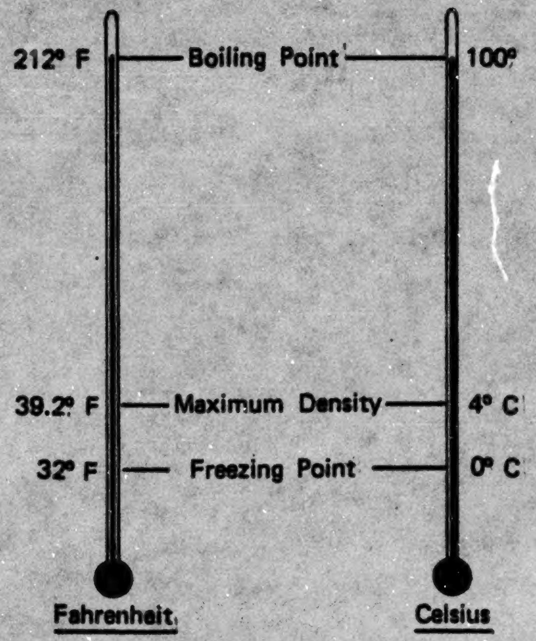
Example: 212° F. minus 32 = 180, multiplied by 5/9 = 100°C

(NOTE: To multiply by 5/9, multiply by the 5 and then divide the answer by the 9.)

C. Applications

1. 0°C. = 32°F. = freezing point
2. 4C. = 39.2°F. = maximum density of water
3. 37°C. = 98.6°F. = normal human temperature
4. 100°C. = 212°F. = boiling point of water (Figure 2)

FIGURE 2


212° F
Boiling Point
100°
39.2° F
Maximum Density
4° C
32° F
Freezing Point
0° C
Fahrenheit
Celsius

V. Metric liquid measurements

A. Abbreviations

1. ml = milliliter
2. l = liter

INFORMATION SHEET

B. Conversions

100 ml = 0.10 liter = approximately 1/5 pint

250 ml = 0.25 liter = approximately 7/16 pint

500 ml = 0.50 liter = approximately 7/8 pint

750 ml = 0.75 liter = approximately 1-5/16 pint

1000 ml = 1.00 liter = approximately 1-3/4 pint

4.54 liter = approximately 1 gallon

C. Applications

1. 30 gallon water heater = approximately 136 liters
2. 40 gallon water heater = approximately 181 liters
3. 60 gallon water heater = approximately 272 liters

VI. Metric mass measurements

A. Abbreviations

1. g = gram
2. kg = kilogram

B. Conversion

50g = 0.05kg = approximately 1-3/4 ounces

250g = 0.25kg = approximately 8 1/2 ounces

500g = 0.50kg = approximately 1 lb. 1 ounce

750g = 0.75kg = approximately 1 lb 10 ounces

1000g = 1.00kg = approximately 2 lb 2 ounces

C. Applications

1. 22 lb. wall hung lavatory = 10kg
2. 88 lb. water closet = 40 kg
3. 154 lb. cast iron bathtub = 70 kg

METRIC MEASUREMENT FOR PLUMBERS
UNIT V

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. System currently used in the United States; measurements are in inches, feet, and yards, and temperature is measured in Fahrenheit degrees

_____b. System used in most of the world; measurements are in millimeters, meters, and kilometers, and temperature is measured in Celsius degrees

_____c. International System of Units, modern version of the metric system

_____d. Referring to the metric system as being divisible into 10 parts

_____e. Word adopted by the metric system for weight

_____f. Measurement of lines, length or width

_____g. The point water reaches at 39.2°F

1. Metric system
2. SI
3. English system
4. Mass
5. Maximum density of water
6. 10th multiple
7. Lineal

2. Select true statements representing the history of the metric system by placing an "X" next to the statements that are true.

_____a. 1670--French astronomer proposed first system based on decimal (10) divisions of the earth's circumference

_____b. 1790--French Academy of Sciences developed metric system and coined the word meter as the basic unit of lineal measurement

_____c. 1840--France officially adopts the metric system followed by two other European countries

_____d. 1866--United States adopts the metric system by a vote of the people

_____e. 1875--The Treaty of the Metre was established by 17 countries, but not the United States, to refine and promote the metric system

_____f. 1960--International System of Units established to revise and simplify the system

_____g. 1971--The U.S. Department of Commerce recommended to the congress that the U.S. change to the metric system through a coordinated national program

3. Convert approximate pipe sizes and lengths from the English system to the metric system.

   a. 1" diameter pipe = ____________

   b. 1 1/4" diameter pipe = ____________

   c. 1 1/2" diameter pipe = ____________

   d. 2" diameter pipe = ____________

   e. 3" diameter pipe = ____________

   f. 4" diameter pipe = ____________

   g. 10" length = ____________

   h. 20" length = ____________

   i. 100" length = ____________

4. Convert temperature measurements from the English system to the metric system.

   a. 0°C. = ____________________________

   b. 4°C. = ____________________________

   c. 37°C. = ____________________________

   d. 100°C. = ____________________________

5. Convert liquid measurement from the English system to the metric system.

   a. 30 gallon water heater = ____________________

   b. 40 gallon water heater = ____________________

   c. 60 gallon water heater = ____________________

6. Convert weight (mass) measurement from the English system to the metric system.

   a. 22 lb. wall hung lavatory = ____________________

   b. 88 lb. water closet = ____________________

   c. 154 lb. cast iron bath tub = ____________________

METRIC MEASUREMENT FOR PLUMBERS
UNIT V

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 2
   d. 6
   e. 4
   f. 7
   g. 5
2. a, b, f, g
3. a. 25mm pipe
   b. 32mm pipe
   c. 38mm pipe
   d. 50mm pipe
   e. 75mm pipe
   f. 100mm pipe
   g. 250mm or 25cm
   h. 500mm or 50cm
   i. 2500 mm or 250cm
4. a. 32°F. = freezing point
   b. 39.2°F = maximum density of water
   c. 98.6°F. = normal human temperature
   d. 212°F = boiling point of water
5. a. 136 liters
   b. 181 liters
   c. 272 liters

6. a. 10kg

   b. 40kg

   c. 70kg

DRAINAGE SYSTEMS
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with drainage systems, and be able to describe, identify, and list the parts and functions of a drainage system. The student should also be able to discuss trenching, shoring, and trenching hazards and safety precautions. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with drainage systems to the correct definitions or descriptions.
2. Identify soil, waste, and vent pipes in a drainage system.
3. Distinguish between materials used in soil and waste pipes.
4. State the functions of soil, waste, and vent pipes in a drainage system.
5. State purposes of plumbing traps.
6. Select types of traps.
7. Identify various types of pipe hangers, clamps, and supports.
8. Match pipe hangers, clamps, and supports to their uses.
9. Distinguish between the location, materials, and functions of building sewers and storm drains.
10. Discuss the installation of building sewers and storm drains.
11. List steps used when adding new plumbing to an old system during the planning and roughing-in stages.
12. Discuss the water and air methods of testing drainage systems for leaks.
13. Discuss trenching techniques.
14. Discuss shoring materials and devices.
15. Discuss trenching hazards and their safety precautions.
16. Label a cross section of a P-trap.
17. Identify fittings required on a drainage system.

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18. Demonstrate the ability to:

    a. Install a bathtub waste and overflow and trap on a two story building.
    b. Install a prefabricated shower base drain (caulked method).
    c. Lay out trench lines.
    d. Calculate the slope required for building sewer lines.
    e. Install drain pipe in trenches.
    f. Install storm drains.
    g. Backfill trenches.
    h. Install pipe sleeves or thimbles through walls, ceilings, or floors.
    i. Install soil or waste back vents.
    j. Install cleanouts on drains.
    k. Rough-in waste lines and vents for built-in lavatories.
    l. Rough-in waste lines and vents for bathtubs.
    m. Secure with hangers horizontal and vertical lines of pipe to masonry surfaces.
    n. Secure with hangers horizontal and vertical lines of pipe to wood surfaces.
    o. Secure with hangers horizontal and vertical lines of pipe to metal surfaces.
    p. Install vent terminals (roof flashing).
    q. Inspect a plumbing system.

2-D

/

DRAINAGE SYSTEMS
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide student with objective sheet.
- B. Provide student with information, assignment, and job sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information and assignment sheets.
- F. Demonstrate and discuss the procedures outlined in the job sheets.
- G. Conduct a field trip to a construction site.
- H. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete assignment and job sheets.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
    1. TM 1--Soil, Waste, and Vent Pipes
    2. TM 2--Soil, Waste, and Vent Pipes (Continued)
    3. TM 3--Types of Traps

P-3-D

4. TM 4--Pipe Hangers, Clamps, and Supports

5. TM 5--Pipe Hangers, Clamps, and Supports (Continued)

6. TM 6--Building Sewers and Storm Drains

7. TM 7--Adding New Plumbing to an Old System

8. TM 8--Testing for Leaks

D. Assignment sheets

1. Assignment Sheet #1--Draw a Cross-Section of a P-Trap

2. Assignment Sheet #2--Identify Fittings in a Drainage System

E. Answers to assignment sheets

F. Job sheets

1. Job Sheet #1--Install a Bathtub Waste Overflow and Trap on a Two Story Building

2. Job Sheet #2--Install a Prefabricated Base Drain (Caulked Method)

3. Job Sheet #3--Lay Out Trench Lines

4. Job Sheet #4--Calculate the Slope Required for Building Sewer Lines

5. Job Sheet #5--Intall Drain Pipe in Trenches

6. Job Sheet #6--Install Storm Drains

7. Job Sheet #7--Backfill Trenches

8. Job Sheet #8--Install Pipe Sleeves or Thimbles Through Walls, Ceilings, or Floors

9. Job Sheet #9--Install Soil or Waste Back Vents

10. Job Sheet #10--Install Cleanouts on Drains

11. Job Sheet #11--Rough-in Waste Lines and Vents for Built-In Lavatories

12. Job Sheet #12--Rough-in Waste Lines and Vents for Bathtubs

13. Job Sheet #13--Secure with Hangers Horizontal and Vertical Lines of Pipe to Masonry Surfaces

14. Job Sheet #14--Secure with Hangers Horizontal and Vertical Lines of Pipe to Wood Surfaces

15. Job Sheet #15--Secure With Hangers Horizontal and Vertical Lines of Pipe to Metal Surfaces

16. Job Sheet #16–Install Vent Terminals (Roof Flashing)

17. Job Sheet #17–Inspect a Plumbing System

G. Test

H. Answers to test

II. Unit references:

A. Manus, Vincent. *National Plumbing Code* Illustrated. St. Petersburg, FL: Manus Publications, 1973.

B. Blankenbaker, E. Keith. *Modern Plumbing*. South Holland, IL: Goodheart-Willcox, 1978.

C. *Building Construction*. Columbia, MO: University of Missouri/ Instructional Materials Laboratory, 1973.

III. Additional references:

A. Ohio State University Research Foundation. *The World of Construction*. Bloomington, IL: McKnight and McKnight Pub. Co., 1970.

B. Navy Education and Training Command, Rate Training Manual, NAVEDTRA 10657-E. Government Printing Office, Washington, D.C., 1973.

P-5-D

DRAINAGE SYSTEMS
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. D.W.V.--Drain, waste, and vent

B. Pitch--Slope or grade given to a horizontal run of pipe to permit gravity flow of liquid

C. Drain pipe--Pipe which carries waste water

D. Cleanout--Access point to drain or trap for the purpose of removing obstruction

E. Flashing--Shield that fits over vent pipe on roof to prevent water from entering house through roof opening

F. Syphoning--Creating a partial vacuum in a pipe so that water can be drawn into it

(NOTE: Traps can be emptied if vacuum is not reduced by venting.)

G. Soil stack--Pipe which connects water closets to building drain and extends up and out of house roof to serve as a vent

H. Rough-in--Initial stages of plumbing installation which include bringing the water and sewer lines into the building and topping out or installing all pipes which will be enclosed in the walls

I. Vent stack--The vertical extension of the drainage system through the roof and all that piping above the highest horizontal drain which is connected to the stack

II. Soil, waste, and vent pipes in a drainage system (Transparencies 1 and 2)

(NOTE: Check local codes.)

A. Soil pipes

(NOTE: Soil pipes extend from the house sewer (5' maximum outside of building) to highest branch connected to water closets.)

1. Building drain
2. Soil stack

B. Waste Pipes

(NOTE: Waste pipes extend from the main soil or vent stack to the fixture traps.)

P-7-D

INFORMATION SHEET

1. Building drain branch
2. Waste stack
3. Horizontal branch
4. Fixture drain

C. Vent pipes

(NOTE: Every fixture must be vented; therefore, vent pipes extend from the fixture to the main vent stack or go directly through the roof to the atmosphere.)

1. Vent stack
2. Stack vent
3. Individual vent
4. Branch vent
5. Wet vents

D. Other pipes and materials

1. City sewer
2. Building sewer
3. Cleanout
4. Stack cleanout
5. Fixture trap
6. Roof flashing

III. Materials used in soil and waste pipes

A. Soil pipes

(NOTE: The minimum size for soil pipe is 3".)

1. Cast iron
2. Copper
3. Plastic

INFORMATION SHEET

B. Waste pipes

(NOTE: The minimum size for waste pipe is 1 1/4".)

1. Copper
2. Plastic
3. Galvanized steel
4. Cast iron

IV. Functions of soil, waste, and vent pipes

A. Soil pipes–Carry drainage which includes fecal matter (toilet discharge)

B. Waste pipes–Carry liquid waste which does not contain fecal matter (toilet discharge)

C. Vent pipes

1. Vent pipes allow free air to circulate in the system as the "vent" or terminal is open to the atmosphere above the building roof
2. Vent pipes provide equalization of air pressure on both sides of the fixture trap, thus preventing the syphoning of the trap
3. Vent pipes minimize back-pressure on trap seals thus preventing loss of seal

V. Purposes of plumbing traps (Transparency 3)

A. Provides a liquid seal which will prevent the back passage of air without affecting the flow of sewage or waste water through it

B. Prevents sewer gas from entering the building through the fixture

C. Prevents vermin from entering the building through the fixture

VI. Types of traps (Transparency 3)

(NOTE: Check local codes.)

A. P-trap

B. S-trap

(NOTE: The S-trap is illegal.)

C. Running trap

D. Drum trap

INFORMATION SHEET

VII. Types of pipe hangers, clamps and supports (Transparencies 4 and 5)

A. Piers

(NOTE: Piers should be made of masonry or other material that will not deteriorate easily.)

B. Straps

C. Pipe Hook

D. Pipe clamp

E. Clevis hanger

F. Riser clamp

VIII. Uses of pipe hangers, clamps and supports (Transparencies 4 and 5)

A. Pier--Supports base of stack and horizontal runs of large pipe near floor or ground level

B. Strap--Supports small size pipes by attaching to walls, beams, and ceilings

C. Wires hook--Supports small to medium size pipes to wooden beams and joists

D. Pipe clamp--Supports small to medium size pipes to any kind of ceiling or wall structure

E. Clevis hanger--Supports medium to large size pipes to ceilings or wall structure

F. Riser clamp--Supports stacks and other large pipe when additional vertical support is needed

(NOTE: Pipes should not be used as structural supports.)

IX. Location, materials, and function of building sewers and storm drains (Transparency 6)

A. Building sewers

1. Location--Between building drain and sewer main (or septic tank)

2. Materials

a. Cast iron

b. Vitrified clay (and locally approved material)

3. Function--To carry sewage from the building to the main sewer

INFORMATION SHEET

- B. Storm drains
    - 1. Location--In, under, and/or outside building
    - 2. Materials
        - a. Cast iron
        - b. Vitrified clay
        - c. Plastic
        - d. Galvanized steel

          (NOTE: Sheet metal for leaders, gutters, etc.)
    - 3. Function--To carry off rain water and other uncontaminated water in a system independent of the sewage system

X. Installation of building sewers and storm drains

(NOTE: Check with local codes.)

- A. Building sewers
    - 1. Excavation of trench should be clean and neat
    - 2. Pipe should be laid alongside trench for easy access
    - 3. Trench should be graded or given pitch to allow for gravity drainage of sewer pipe

      (NOTE: 1/8" per foot pitch is sufficient for sewer pipe.)
    - 4. In some instances, a "lateral" is provided by the city and the plumber must first establish the actual depth of this lateral

      (NOTE: If a lateral is not provided by the city, the plumber is often required to make the connection to the main sewer.)
- B. Storm drains
    - 1. Usually not trapped
    - 2. Extended drain pipe might be perforated to disperse water into ground
    - 3. Drain pipe might empty into:
        - a. Dry well
        - b. Lake, pond, or stream

P-11-D

4. Drain pipes around foundations are perforated to collect and carry seepage water away from building

XI. Adding new plumbing to an old system (Transparency 7)

A. Planning

1. Check local plumbing code
2. Determine location and design
3. Determine availability of existing plumbing
4. Develop material list

(NOTE: It is extremely important to plan ahead and have the proper fittings for cutting into the system.)

B. Roughing-in the drainage

1. Determine layout of new fixtures
2. Cut out access holes and openings for new pipe installation

(CAUTION: Care must be taken to avoid weakening building structure.)

3. Cut into the existing drainage system

(CAUTION: Fires are a constant hazard in addition work and remodeling.)

4. Install drainage pipes

(NOTE: Follow local codes for pipe sizing, venting, and local ordinances.)

C. Roughing-in water distribution pipes

1. Cut into existing water system

(NOTE: The end or terminal point of the water system might not be of sufficient size to supply the new addition.)

2. Cut and/or drill access holes and openings for new pipe installation
3. Install water distribution pipes

(NOTE: Test for leaks before enclosing pipes in floors or walls.)

XII. Water and air methods of testing drainage systems for leaks (Transparency 8)

INFORMATION SHEET

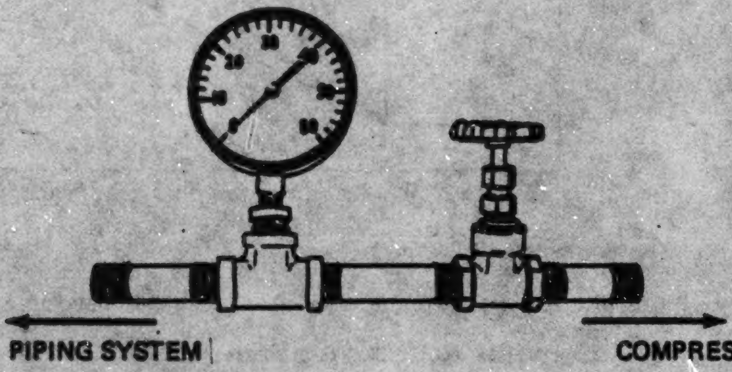
(NOTE: Both types of tests can be done on the entire system or sections of the system. Check local codes.)

A. Water

1. If entire system is tested, fill the system until water overflows the vent stack above the roof
2. If sections of the system are tested, a 10' head must be applied to the tested section
3. Allow water to remain in system for 15 minutes prior to the test
4. Visually inspect all joints of the tested system
5. If no leaks are found, the system is tight at all joints

B. Air

1. Attach air compressor testing apparatus to any suitable opening (Figure 1)



2. Close all other inlets and outlets
3. Test system by maintaining 5 p.s.i. pressure for 15 minutes

   (NOTE: Leaks can be detected by sound, soap and water, or by some odor injected into the system. In some cases a final test of the system may be required by putting 2 ounces of oil of peppermint in the system. Smoke tests are also used as a final test. This is done by filling all traps with water, producing smoke by a smoke machine, and sealing the vent terminal. A pressure equivalent to 1 inch water column must be maintained for 15 minutes.)

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INFORMATION SHEET

XIII. Trenching techniques

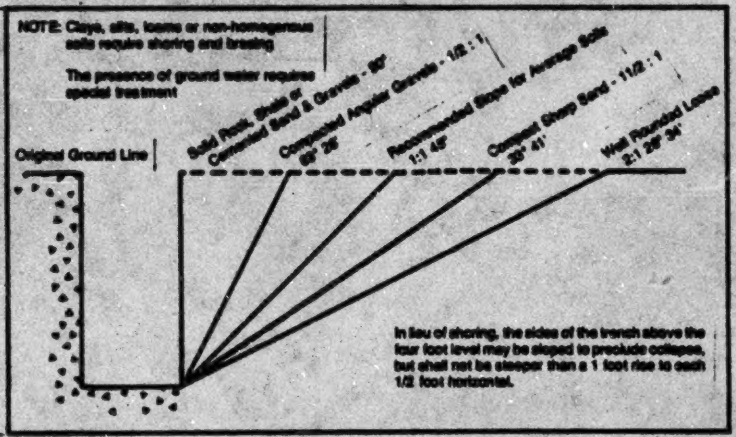
A. Open trenching

1. Angle of repose must be adequate

2. Depends on types of soil

3. Demands careful attention to slope

4. Open trenching is acceptable only when soil type and space permit a safe angle of repose. See Figure 2.


Original Ground Line
Solid Rock, Shale or Cemented Sand & Gravels - 90°
Compacted Angular Gravels - 1/2 : 1 63° 26'
Recommended Slope for Average Soils 1:1 45°
Compacted Sharp Sand - 1 1/2 : 1 33° 41'
Well Rounded Loose 2:1 26° 34'

NOTE: Clays, silts, loams or non-homogenous soils require shoring and bracing

The presence of ground water requires special treatment

In lieu of shoring, the sides of the trench above the four foot level may be sloped to preclude collapse, but shall not be steeper than a 1 foot rise to each 1/2 foot horizontal.

Figure 2. Angle of repose for the sides of excavations

B. Shored trenching

1. Always use proper shoring in potentially dangerous excavations

2. Federal (O.S.H.A.) standards require shoring were excavation walls exceed a depth of four feet, and trenches must have a ladder for every 25 feet of lateral

XIV. Shoring materials and devices

A. Materials

1. Timber bracing--Wooden stanchions placed at intervals and supported by wooden braces

2. Light timber sheeting--Continuous, tightly arranged wooden stanchions held by wooden cross members

3. Sheet piling--A pile or sheeting that forms a continuous support wall, or a row of timber, concrete, or steel piling driven to assure a tight supporting wall against earth pressure

INFORMATION SHEET

B. Devices

1. Trench box--A continuous supportive box of wood and/or metallic supports to retain the earth

2. Hydraulic shores--Hydraulic jacks, usually made of aluminum, activated by a hydraulic pump

3. Screw jacks--Metallic screw devices with foot supports on both edges; they hold timbers or boards against the trench face

XV. Trenching hazards and their safety precautions

A. Materials and tools falling into the trench

1. All pipes or tools used on the job should be placed at least two feet from the edge of a trench

2. All workers should wear hard hats to protect themselves from devices or tools accidentally dropped in the trench

3. Pipe should be handed carefully into a trench, not dropped or rolled

4. Heavy tools and pipe should be handled by two or more workers to avoid heavy materials getting out of control

5. Move pipe and equipment only as required

6. Never stack materials by the edge of a trench or any excavation

B. Excavated debris falling into the trench

1. Earth, rocks, or other materials removed from the trench should be placed at least two feet from the edge

2. Avoid piling excavated materials too high since this could overload the trench wall and create a potential cave in

C. Machinery falling into an excavation

1. Beware of operating equipment at all times and maintain a safe distance

2. If operating equipment vibrates excessively, notify a foreman; this vibration could be transmitted through soil to the trench wall and cause a cave in

3. Note any careless or unskilled machine operators and suggest to the appropriate foreman that the situation be corrected

D. Debris falling from working machinery

P-15-D

INFORMATION SHEET

1. Wear a hard hat for all trenching operations
2. Wear goggles anytime there is a potential for flying debris

E. Machinery hitting power or ultility lines

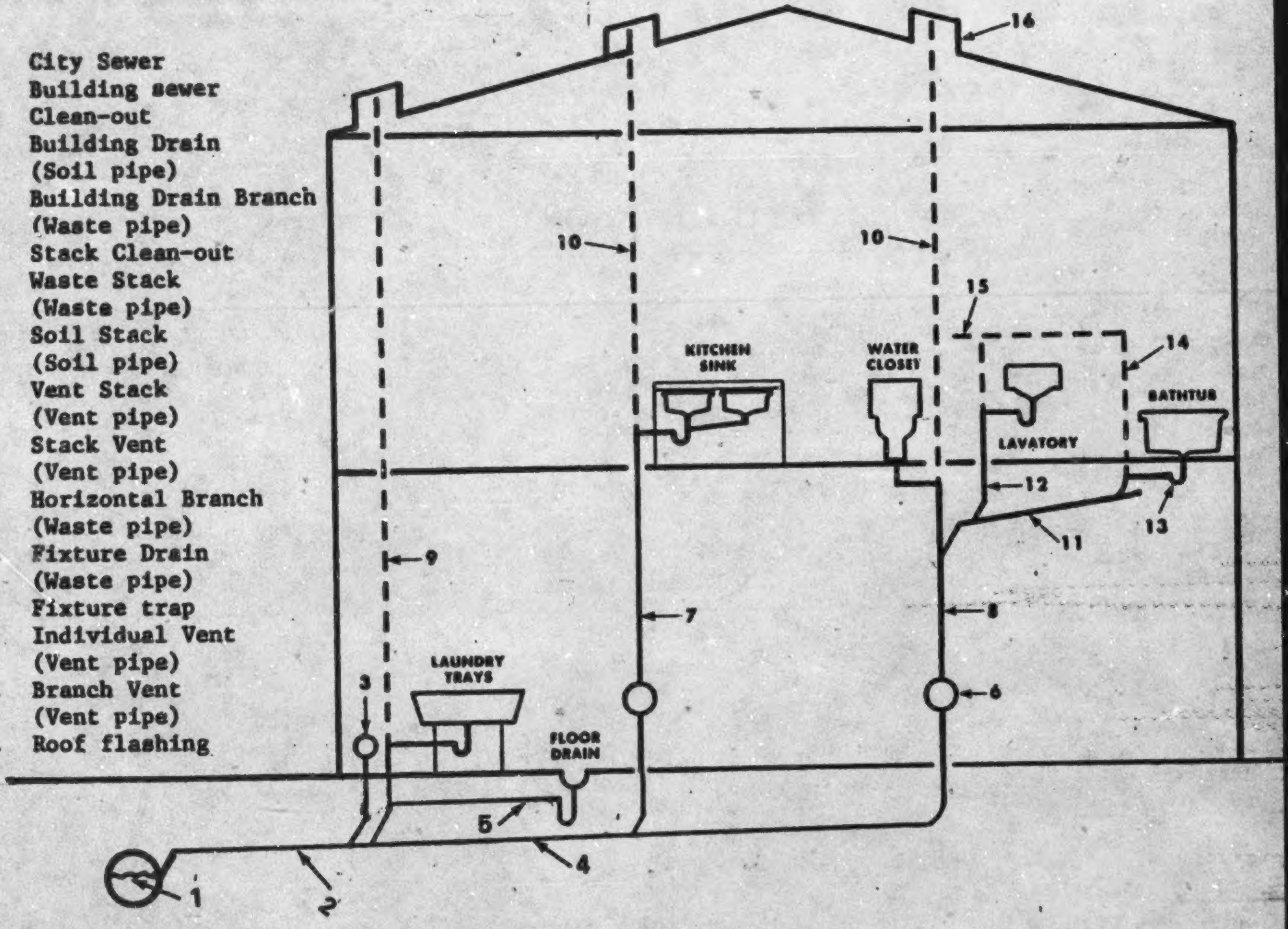
1. Locate and mark underground obstacles: water, gas, telephone, electric, and steam lines, storm drains, sprinklers, and other equipment piping
2. Locate and mark overhead obstacles: power, lighting, and telephone lines and trees or man made obstacles

F. People falling into an open trench

1. Secure the job site at all times, especially at night, keeping in mind that curious children find job sites are interesting playgrounds
2. Cover all open trenches with timber or plywood strong enough to support a reasonable amount of weight
3. Position the protective sheathing so it will not only protect the public from danger but serve to shield the trench from rain water
4. Reflective barricades and lights around the trench add additional protection for both curious passersby and animals

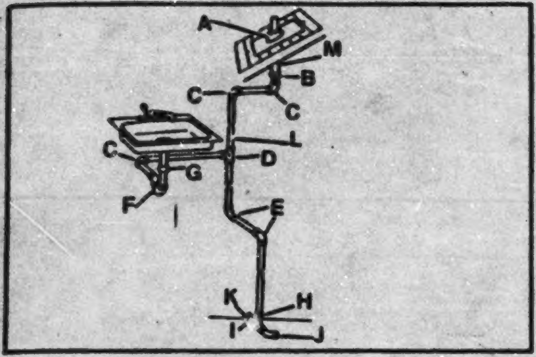
Soil, Waste, and Vent Pipes

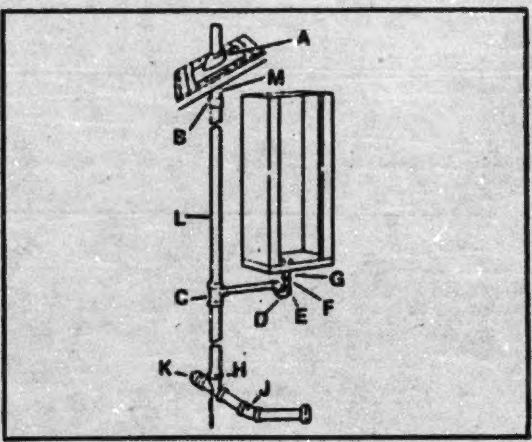
1. City Sewer
2. Building sewer
3. Clean-out
4. Building Drain (Soil pipe)
5. Building Drain Branch (Waste pipe)
6. Stack Clean-out
7. Waste Stack (Waste pipe)
8. Soil Stack (Soil pipe)
9. Vent Stack (Vent pipe)
10. Stack Vent (Vent pipe)
11. Horizontal Branch (Waste pipe)
12. Fixture Drain (Waste pipe)
13. Fixture trap
14. Individual Vent (Vent pipe)
15. Branch Vent (Vent pipe)
16. Roof flashing


16
10
10
15
14
KITCHEN SINK
WATER CLOSET
BATHTUB
LAVATORY
12
13
11
9
7
8
LAUNDRY TRAYS
3
6
FLOOR DRAIN
5
4
1
2

Soil, Waste, and Vent Pipes

(Continued)





KITCHEN SINK ONLY

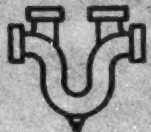
CODE	DESCRIPTION	SIZE	QTY.
A	Roof Flashing	2"	1
B	Increasing Coupling	1 1/2 x 2"	1
C	90° Elbows	1 1/2"	3
D	Sanitary Tee	1 1/2"	1
E	45° Elbows	1 1/2"	2
F	"P" Trap	1 1/2"	1
G	Male Iron Pipe Trap Adapter	1 1/2"	1
H	Plastic To 2" Iron Hub	1 1/2"	1
I	Cast Iron "Y" Branch	2"	1
J	Cast Iron 1/8" Bend	2"	1
K	Cleanout Ferrule	2"	1
L	Plastic Pipe	1 1/2"	20 Ft.
M	Plastic Pipe	2"	10 Ft.

SHOWER ONLY

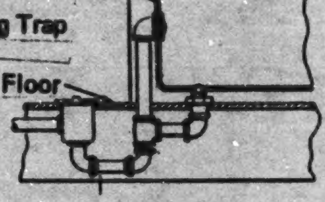
CODE	DESCRIPTION	SIZE	QTY.
A	Roof Flashing	2"	1
B	Increasing Coupling	2"	1
C	Sanitary Tee	1 1/2"	1
D	"P" Trap	1 1/2"	1
E	Male Iron Pipe Adapter	1 1/2"	1
F	Reducing Coupling	2" x 1 1/2"	1
G	Galvanized Nipple	2" x 6"	1
H	Plastic to 2" Iron Hub	1 1/2"	1
I	Cast Iron "Y" Branch	2"	1
J	Cast Iron 1/8" Bend	2"	1
K	Cleanout Ferrule	2"	1
L	Plastic Pipe	1 1/2"	20 Ft.
M	Plastic Pipe	2"	10 Ft.

Types of Traps

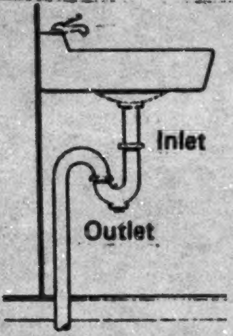
(Refer to Local Codes)



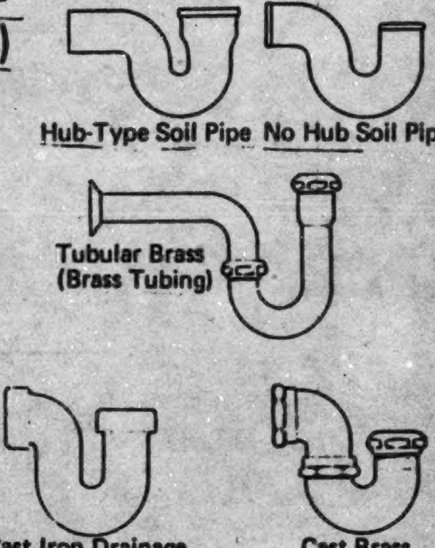
Running Trap



Drum trap on bathtub drain.


Inlet
Outlet

"S" TRAP (ILLEGAL)

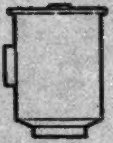


Hub-Type Soil Pipe No Hub Soil Pipe

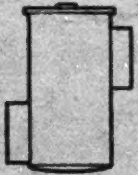
Tubular Brass (Brass Tubing)

Cast Iron Drainage Cast Brass

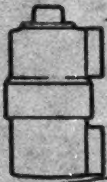
P-traps of various piping materials.



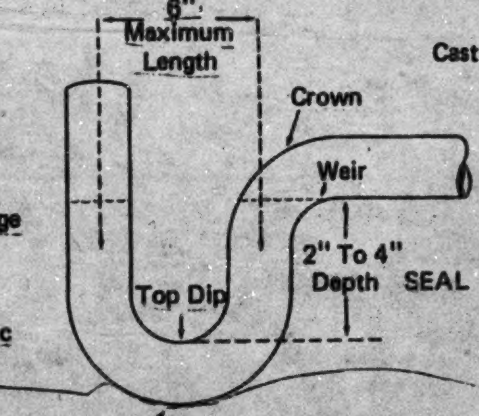
4x5 Cast Iron Drainage



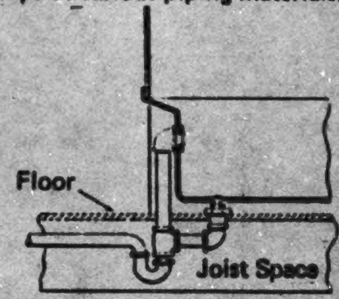
4x8 Cast Iron Drainage



3x6 DWV Plastic


6" Maximum Length
Crown
Weir
2" To 4" Depth SEAL
Top Dip
Bottom Dip

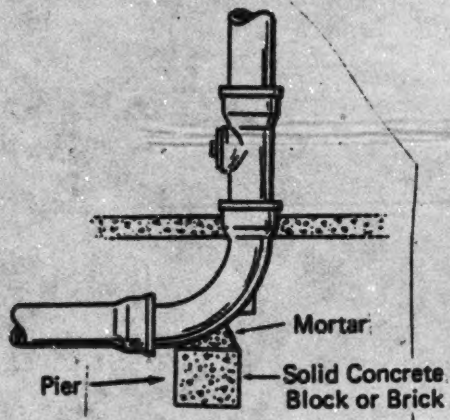
Trap Seal


Floor
Joist Space

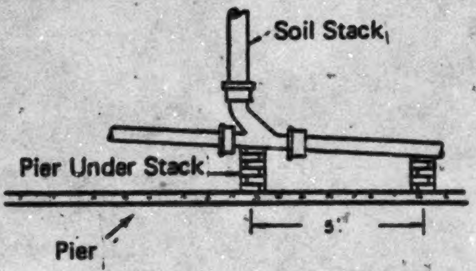
P-trap installed on a bathtub drain

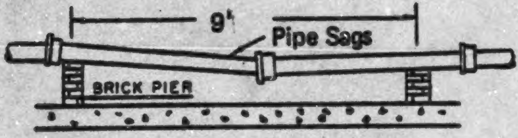
Pipe Hangers, Clamps, and Straps

(Refer to local Codes)


Mortar
Pier
Solid Concrete Block or Brick

Underground Stack Base Support

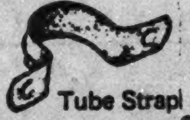

Soil Stack
Pier Under Stack
5'
Pier

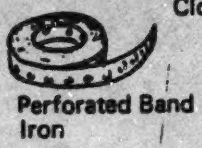

9'
Pipe Sags
BRICK PIER

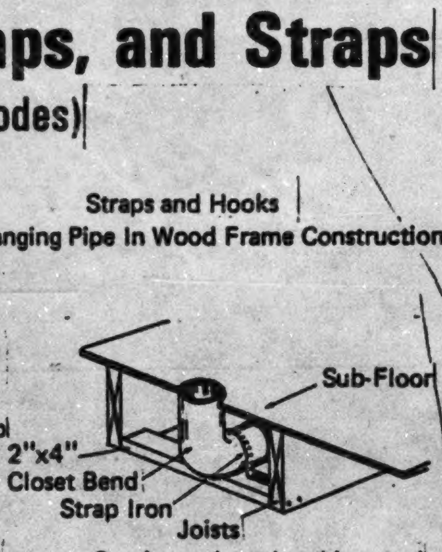
Each joint must be supported

Piers

Straps and Hooks
For Hanging Pipe In Wood Frame Construction:

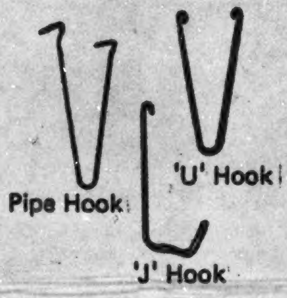


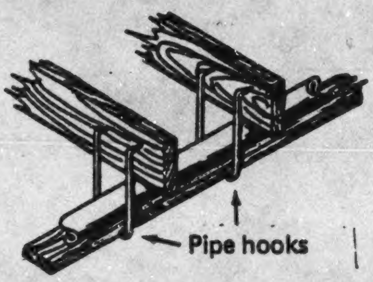

Perforated Band Iron


Sub-Floor
2"x4"
Closet Bend
Strap Iron
Joists

Bracing a closet bend in wood frame construction.

Straps


Pipe Hook
'U' Hook
'J' Hook

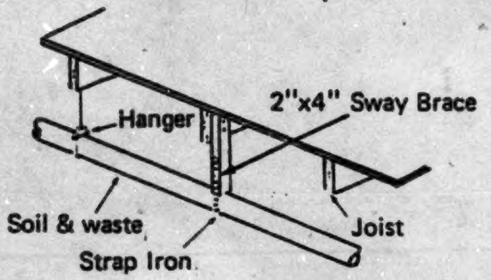


Plastic pipe must be supported on continous wood or metal strips when it conveys hot water waste.

Hooks

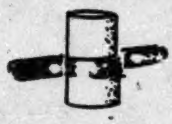
Pipe Hangers, Clamps, and Straps

(Continued)

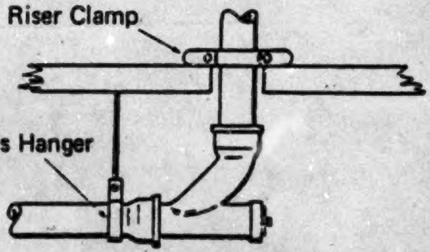

Hanger
2"x4" Sway Brace
Soil & waste
Strap Iron
Joist

Horizontal pipe with a sway brace.

For Supporting Vertical Pipe

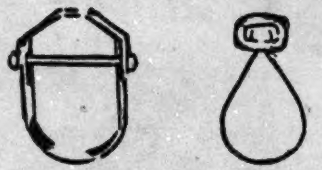


Riser Clamp

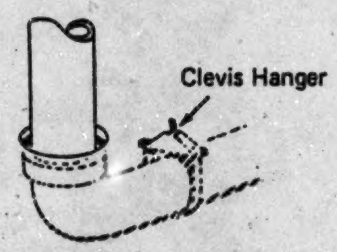

Riser Clamp
Clevis Hanger

Support of above-ground stack base fitting using a riser clamp or a clevis hanger

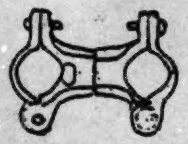
For Hanging Horizontal Pipes From Ceilings:



Clevis Hanger　Adjustable Ring

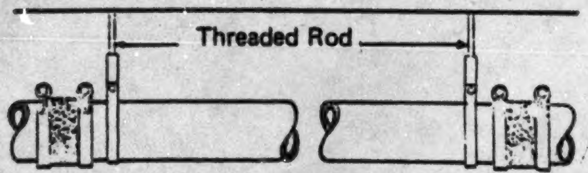

Clevis Hanger

A method of supporting a closet bend using a clevis hanger



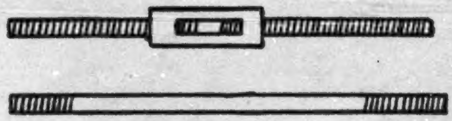
Split Pipe Clamps Back To Back

Pipe Clamp


Threaded Rod

Hangers on a 10-foot length of no-hub soil pipe.

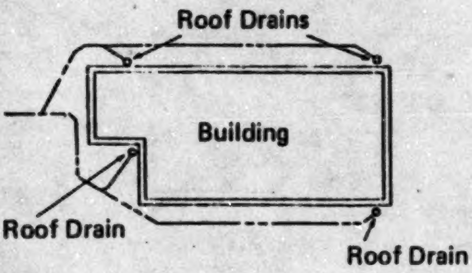
Clevis Hangers



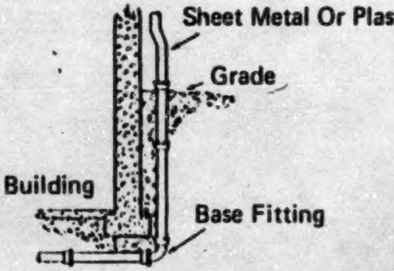
Threaded Rod

Building Sewers and Storm Drains

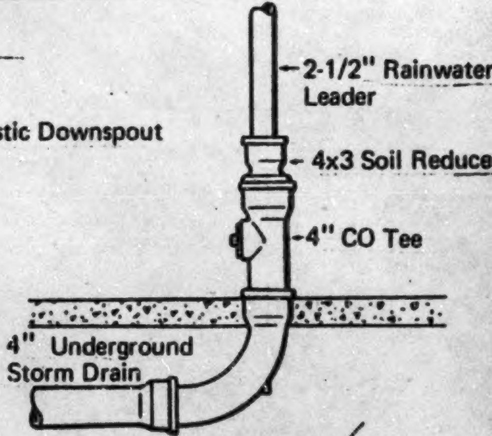
(Refer to Local Codes)

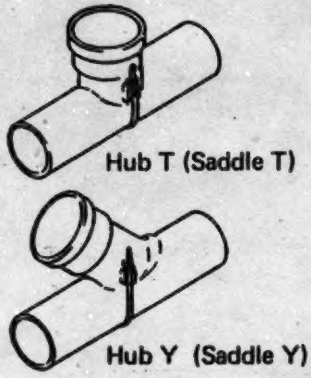

Roof Drains
Building
Roof Drain
Roof Drain

Outside Storm Drain


Sheet Metal Or Plastic Downspout
Grade
Building
Base Fitting

Base Fitting Connection
For Outside Rainwater

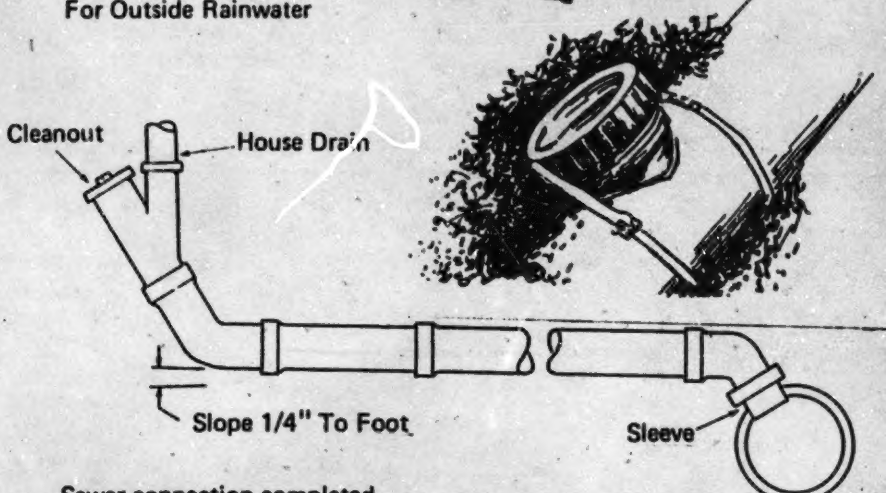

2-1/2" Rainwater
Leader
4x3 Soil Reduce
4" CO Tee
4" Underground
Storm Drain



Hub T (Saddle T)

Hub Y (Saddle Y)

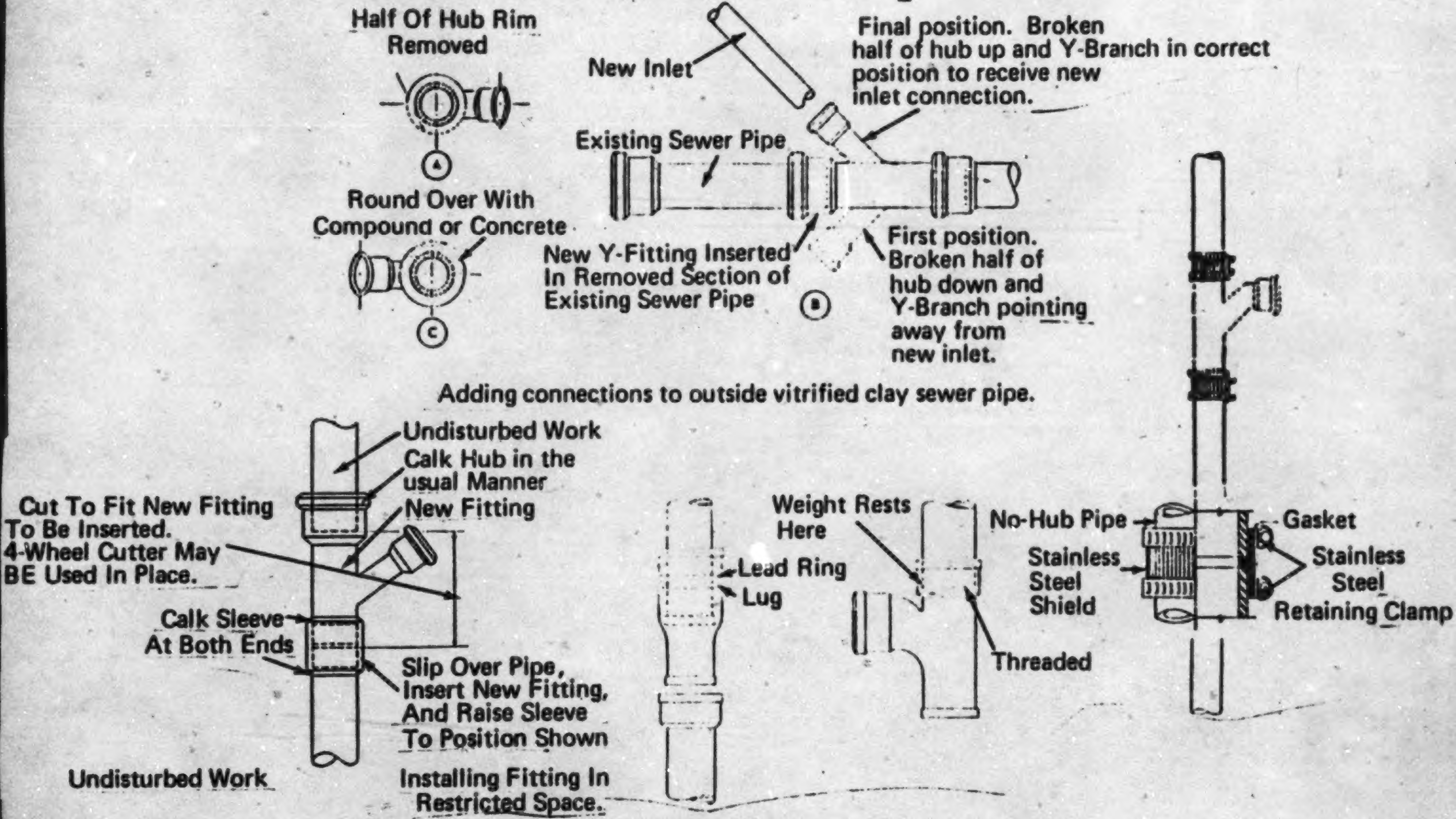
Hub Y and Hub T can be tapped into pipe where new lines are to be added


Cleanout
House Drain
Slope 1/4" To Foot
Sleeve

Sewer connection completed.
A-Sleeve connector is cemented in place with a quick-setting plastic. cement will be placed around joint for added protection.
B-Completed sewer line will slope from the house drain to the sewer main.

Adding New Plumbing to an Old System

(Refer to Local Codes)


Half Of Hub Rim Removed
A
Round Over With Compound or Concrete
C
New Inlet
Final position. Broken half of hub up and Y-Branch in correct position to receive new inlet connection.
Existing Sewer Pipe
New Y-Fitting Inserted In Removed Section of Existing Sewer Pipe
B
First position. Broken half of hub down and Y-Branch pointing away from new inlet.
Undisturbed Work
Calk Hub in the usual Manner
New Fitting
Cut To Fit New Fitting To Be Inserted. 4-Wheel Cutter May BE Used In Place.
Calk Sleeve At Both Ends
Slip Over Pipe, Insert New Fitting, And Raise Sleeve To Position Shown
Undisturbed Work
Lead Ring
Lug
Weight Rests Here
Threaded
No-Hub Pipe
Stainless Steel Shield
Gasket
Stainless Steel Retaining Clamp

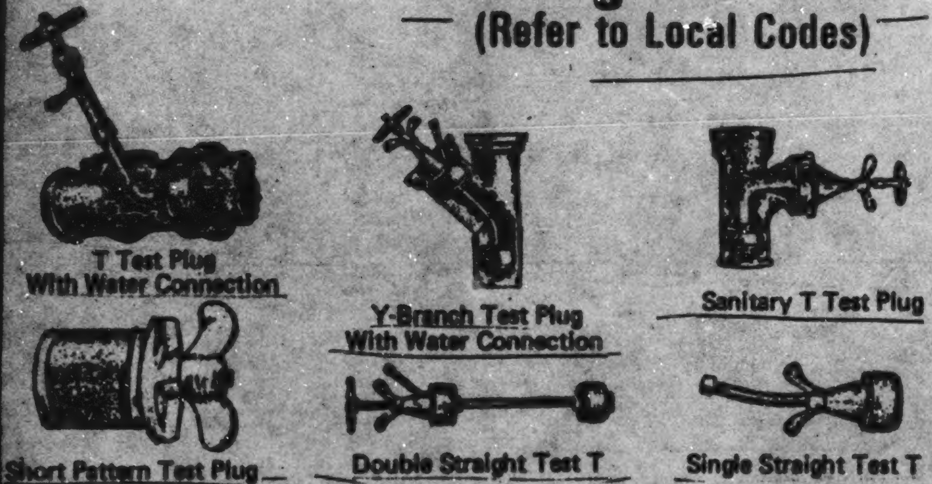
Adding connections to outside vitrified clay sewer pipe.

Installing Fitting In Restricted Space.

Cutting into the Existing Drainage System

Testing For Leaks

(Refer to Local Codes)



T Test Plug With Water Connection

Y-Branch Test Plug With Water Connection

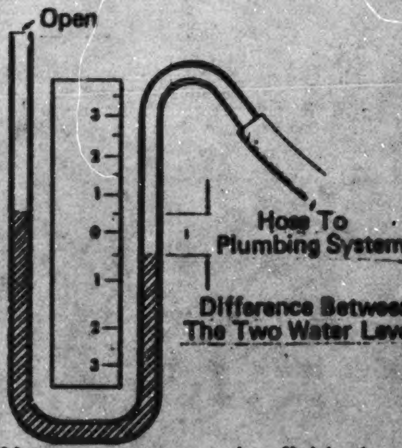
Sanitary T Test Plug

Short Pattern Test Plug

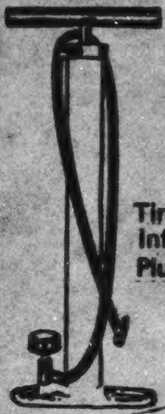
Double Straight Test T

Single Straight Test T

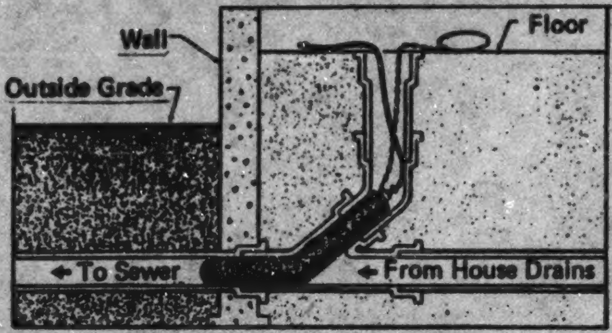
A variety of test plugs may be used to seal openings in the piping so that tests can be conducted.


Open
3
2
1
0
1
2
3
Hose To Plumbing System
Difference Betwee
The Two Water Lev

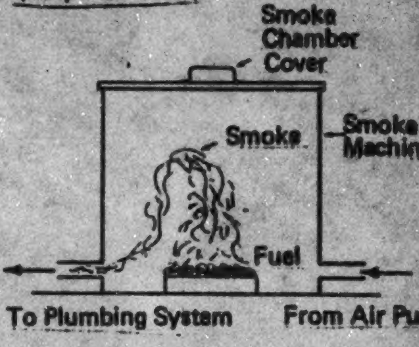
Manometer connected to finished plumbing system. It indicates a pressure equal to a 1-inch water colu
(Ralph Lichliter)



Tire Pump For Inflating Test Plug And Balls


Wall
Floor
Outside Grade
To Sewer
From House Drains

Long inflatable rubber test plug being used to seal the building drain at the front main cleanout opening.
(Cherne Industrial, Inc.)


Smoke Chamber Cover
Smoke
Smoke Machi
Fuel
To Plumbing System
From Air Pu

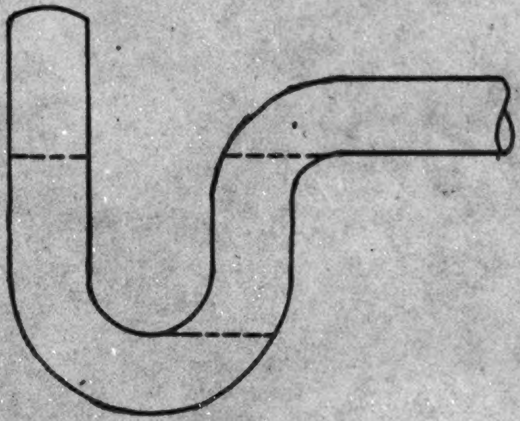
Principle of a smoke machine.

DRAINAGE SYSTEMS
UNIT II

ASSIGNMENT SHEET #1--LABEL A CROSS-SECTION OF A P-TRAP

Directions: Label the following on a cross-section of a P-trap:

1. Inlet
2. Outlet
3. Seal
4. Crown wier
5. Top dip
6. Bottom dip



P-33-D

DRAINAGE SYSTEMS
UNIT I

ASSIGNMENT SHEET #2--IDENTIFY FITTINGS REQUIRED ON A DRAINAGE SYSTEM

(NOTE: Use local code.)

Directions: Identify all the fittings on the following illustration of a drainage system.

A.

B.

C.

D.

E.

F.

G.

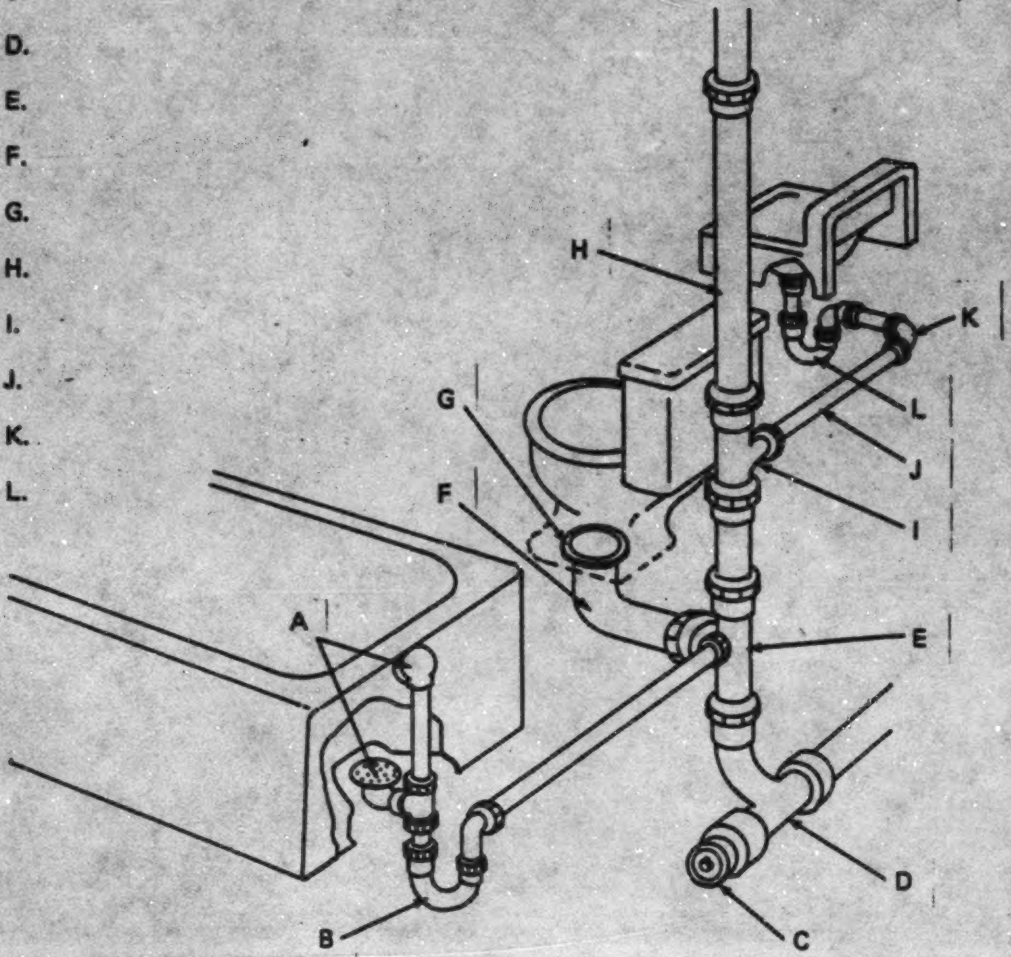
H.

I.

J.

K.

L.



p-25-8

ASSIGNMENT SHEET #3--SECURE A PERMIT FOR THE INSTALLATION OF A PLUMBING SYSTEM

EVALUATION--Given a plumber's license number, information concerning the location where work is to be done, and a knowledge of codes, make application for and secure a plumbing installation permit from a municipal or district permit office. All information supplied should be accurate and be verified by your instructor.

I. Tools and equipment
   - A. License number
   - B. Information concerning a plumbing installation
   - C. Application for permit
   - D. Code book
   - E. Pencil

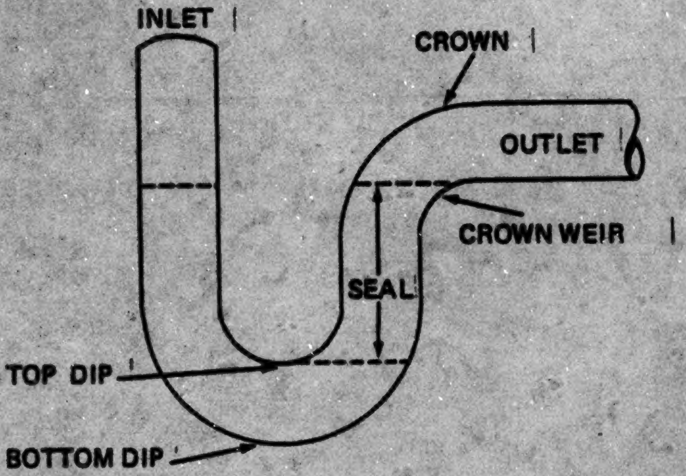
II. Procedure
   - A. Study the information concerning a plumbing installation
   - B. Draw appropriate sketches
   - C. Check with instructor for proper procedure for submitting application
   - D. Secure permit
   - E. Ask instructor for evaluation of work

P-37-D

DRAINAGE SYSTEMS
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1


INLET
CROWN
OUTLET
CROWN WEIR
SEAL
TOP DIP
BOTTOM DIP

Assignment Sheet #2

A. Tub Waste and Overflow

B. P-Trap

C. Cleanout

D. Combination Y and 1/8 bend

E. Sanitary Tee with 1 1/2" Tap

F. Closet Bend

G. Closet Flange

H. Stack Vent

I. Sanitary Tee with 1 1/2" Tap

J. Waste Pipe

K. 90° Ell

L. P-Trap

JOB SHEET #1–INSTALL A BATHTUB WASTE AND OVERFLOW AND TRAP ON A TWO STORY BUILDING

EVALUATION–Given access to tools, equipment, and materials, install a bathtub waste and overflow, and trap. Evaluation will include use of safety precautions, correct use of tools and equipment, quality of workmanship, and neatness of job.

I. Tools and materials

A. Tools

B. Hand saw and pocket knife

C. Adjustable pliers (channel locks)

D. Plug wrench

E. Phillips head screwdriver

F. Straight screwdriver

G. Small adjustable wrench

H. P.V.C. Solvent cement

I. P.V.C. Solvent cleaner

J. Pipe compound

K. 6' stepladder

L. Proper materials, such as tub waste and overflow, and trap (Transparency 10)

II. Procedure

A. Check the tub waste and overflow and trap for missing parts

B. Loosely assemble tub waste and overflow, but exclude trip lever, trip lever cover, and tub drain

(NOTE: A small amount of pipe compound on the threads allows easy tightening.)

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JOB SHEET #1

C. Place tub waste in place and adjust horizontal drain pipe (shoe). Cut if necessary

(NOTE: Make sure beveled gasket is in position behind tub on overflow.)

D. Apply putty under tub drain flange and connect drain while holding tub waste and overflow in position and tighten with plug wrench

(NOTE: Make sure washer under tub is in correct position.)

E. Install trip lever, lever cover, and drain strainer

(NOTE: When final test is made, trip lever should be adjusted to assure complete operation.)

F. Prepare tools and materials on floor lever below tub

G. Place and adjust stepladder under tub drain

H. Determine correct length of tailpiece and waste pips by holding assembled trap in position

(NOTE: It may be necessary to cut to correct length.)

I. Prepare plastic connections for cementing

J. Assemble trap in proper position and cement drain pipe onto trap outlet

K. Tighten slip nut on tub drain pipe

(NOTE: Do not use pipe compound on slip nuts with rubber washer.)

L. Test joints for leaks

(NOTE: These joints should be tested before ceiling is installed.)

M. Clean tools and work area and return tools to proper place

DRAINAGE SYSTEMS
UNIT II

JOB SHEET #2--INSTALL A PREFABRICATED SHOWER BASE DRAIN (CAULKED METHOD)

EVALUATION--Given access to tools, equipment, and materials, install a shower base drain. Evaluation will include use of safety precautions, correct use of tools and equipment, quality of workmanship, and general neatness of the job.

I. Tools and materials

   A. Pipe cutter w/reamer

   B. Caulking irons

   C. Yarning irons

   D. Furnace, lead pot, lead

   E. Ladle

   F. Oakum

II. Procedure

   A. Determine if shower waste pipe has been properly located

   (NOTE: The waste pipe should extend above the floor several inches and at least 1" more than is needed.)

   B. Determine correct height of waste pipe in relationship to shower base

   C. Cut and ream waste pipe to correct height

   D. Place shower base in proper position over waste pipe

   E. Caulk the waste pipe into the shower base drain opening

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JOB SHEET #2

F. Place shower base strainer firmly on drain (Figure 1)

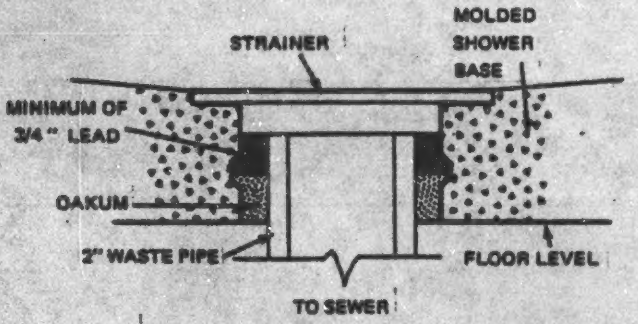
STRAINER
MOLDED
SHOWER
BASE
MINIMUM OF
3/4" LEAD
OAKUM
2" WASTE PIPE
FLOOR LEVEL
TO SEWER

FIGURE 1

G. Clean tools and area and return tools to proper place

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DRAINAGE SYSTEMS
UNIT I

JOB SHEET #3–LAY OUT TRENCH LINES

EVALUATION–Given a set of blueprints, stakes, string, and appropriate tools, lay out a trench. Trench lines must be level, straight, and the correct width apart. Stakes must be securely implanted.

I. Tools and equipment

   A. 6' rule or steel tape

   B. Wooden stakes

   C. Hammer

   D. Roll of string

   E. Blueprints

II. Procedure

   A. Determine location of trench

   B. Locate trench end points

   C. Determine trench width and centerline

   D. Drive two stakes (one on each side) 2" from end of trench equidistant from centerline and maintaining trench width
   (NOTE: The inside of each stake should be on the outside edge of an extended trench line.)

   E. Repeat step D for remaining end of trench

   F. Attach string to inside edge of one stake, stretch taut to inside edge of stake at opposite end of trench on same side, and tie securely (level)

   G. Repeat step F for remaining side of trench

   H. Check with instructor for approval of job

   I. Clean up the area and return all tools and equipment

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JOB SHEET #4–CALCULATE THE SLOPE REQUIRED FOR BUILDING SEWER LINES

EVALUATION–Using a transit level and tripod, calculate the slope required for constructing a building sewer line. The slope tolerance will be a minimum of 1/8" per foot of pipe.

I. Tools and equipment

- A. Transit level and tripod
- B. Pencil and paper
- C. Blueprint

II. Procedure

- A. Locate point where building sewer will join main sewer
- B. Set tripod on top of main sewer pipe; establish grade at this point
- C. Establish grade on sewer pipe stubbed out of building.

  (NOTE: The difference between grades established at main sewer and building sewer is slope required for building sewer line.)
- D. Check with instructor for approval of job
- E. Clean up the area and return all tools and equipment

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JOB SHEET #5--INSTALL DRAIN PIPE IN TRENCHES

EVALUATION--Given access to tools, equipment, and supplies, install clay pipe in a trench on a minimum grade of 1/8" per foot.

I. Tools and equipment

   A. Pointed shovel

   B. 6' rule or steel tape

   C. Nylon line

   D. Wooden stakes

   E. Level

   F. Oakum

   G. Yarning iron

   H. Tar compound

   I. Putty knife

   J. Test plug

   K. Water (for test)

II. Procedure

   A. Determine length of sewer line

   B. Determine if minimum fall from end to end is 1/8" per foot or more

   C. Establish average grade line from end to end

   D. Lay out trench with nylon line and stakes

   E. Dig trench to desired depth, maintaining average grade (minimum 1/8" per foot.)

   F. Lay pipe in trench and check each length for minimum grade

   G. Join each section of pipe

   H. Test for leaks

   I. Backfill trench

JOB SHEET #5

J. Check with instructor for approval of job

K. Return all tools and equipment and clean up the area

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DRAINAGE SYSTEMS
UNIT II

JOB SHEET #6--INSTALL STORM DRAINS

EVALUATION--Provided with a building construction situation, blueprints, and access to plumbing tools, materials and supplies, install a storm drain system for a building with a flat roof. The completed work must be approved by the instructor.

I. Tools and equipment
   - A. Blueprints
   - B. Pipe
   - C. Fittings
   - D. Hangers
   - E. Electric saw
   - F. Roof drains

II. Procedure
   - A. Locate roof drain positions
   - B. Determine piping size per roof area to be drained
   - C. Cut and lay out piping components
   - D. Install drain piping, using appropriate hangers
   - E. Cut holes in roof at designated locations
   - F. Set drains and connect to piping
   - G. Check with instructor for approval of job
   - H. Clean up area and return all tools and equipment

DRAINAGE SYSTEMS
UNIT II

JOB SHEET #7–BACKFILL TRENCHES

EVALUATION–Using a shovel and tamp, backfill a graded drain line. The pipe must not be dislocated or cracked. A 3" overfill of dirt should cover the trench.

I. Tools and equipment

- A. Pointed shovel
- B. Tamp

II. Procedure

- A. Carefully place a six-inch layer of loose dirt in trench and tamp in place
- B. Compact backfill under and beside pipe for support
- C. Place six-inch layers of dirt in trench and tamp until backfill is completed
- D. Overfill trench about 3" for settlement
- E. Check with instructor for approval of job
- F. Clean up area and return shovel and tamp

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DRAINAGE SYSTEMS
UNIT II

JOB SHEET #8–INSTALL PIPE SLEEVES OR THIMBLES THROUGH WALLS, CEILINGS, OR FLOORS

EVALUATION–Given a blueprint, the appropriate tools, nails, wire, and a 3" diameter vent pipe,install a thimble to accommodate a 2 1/2" diameter pipe in an unpoured, formed wall section. Upon completion, the center point of the vent pipe should be the correct distance from reference points indicated on the blueprint; determination will be made by instructor measurement.

I. Tools and equipment

- A. Blueprint
- B. 3" vent pipe
- C. Pencil
- D. 6' rule or steel tape
- E. Tin snips
- F. Electric saw
- G. Hammer and nails
- H. Wire
- I. Pipe

II. Procedure

- A. Using a blueprint, determine thimble center location on both sides of formed wall section
- B. Draw 3" circle around thimble center location on both sides of forms
- C. Cut vent pipe to length equal to wall thickness
- D. Insert prepared vent pipe into space between wall forms and manipulate to desired location–
- E. Drive in nails slightly inside and outside of circle lines to hold vent pipe in place
- F. Wrap and tighten wire around nails and pipe for stability
- G. Check with instructor for approval of job
- H. Clean up area and return all tools and equipment

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JOB SHEET #9–INSTALL SOIL OR WASTE BACK VENTS

EVALUATION–Given fixture manufacturer's rough-in specifications and access to plumbing tools, equipment, and supplies, install a back vent in a plumbing system which accommodates fixtures for two bathrooms installed back to back. The vent connection must be made at least 6" above the flood level rim of the fixtures. All joints must be leak-proof.

I. Tools and equipment
   - A. Rough-in book
   - B. 6' rule or steel tape
   - C. Handsaw and pocket knife
   - D. P.V.C. pipe
   - E. P.V.C. fittings
   - F. P.V.C. solvent cement
   - G. P.V.C. solvent cleaner
   - H. Level
   - I. Electric drilling machine
   - J. Drills
   - K. Safety glasses

II. Procedure
   - A. Determine height required for vent line
   - B. Lay out piping and fittings for horizontal cross vent
   - C. Assemble pipe sections
   - D. Connect pipe sections from fixture drain to main vent or stack
   - E. Check grade of horizontal pipe
   - F. Check with instructor for approval of job
   - G. Return all tools and equipment and clean up the area

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DRAINAGE SYSTEMS
UNIT II

JOB SHEET #10–INSTALL CLEANOUTS ON DRAINS

EVALUATION--Given a 4" cast iron cleanout plug, a drain line under construction, blueprint, and access to plumbing tools and supplies, install a wall or floor type cleanout plug. The cleanout must terminate at an accessible point and open in the direction of the flow of the drainage line or at right angles thereto.

I. Tools and equipment

   A. 6' rule or steel tape

   B. Pencil

   C. Blueprint

   D. Cast iron pipe cutters

   E. 4" cast iron pipe

   F. 4" fittings

   G. 4" compression gasket

   H. Gasket lubricant

   I. 2" X 4" block

   J. Small sledge hammer

II. Procedure

   A. Identify proper location of cleanout plug from construction plans

   B. Determine floor elevation or wall thickness

   C. Cut and install hub of drain pipe to accomodate cleanout

   D. Insert gasket in hub of drain pipe

   E. Lubricate inside of rubber gasket and outside of plug pipe

   F. Insert plug into drain hub and gasket

   G. Drive cleanout plug into drain hub and gasket, using a 2" X 4" block and hammer

   H. Check with instructor for approval of job

   I. Clean up the area and return all tools and equipment

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JOB SHEET #11--ROUGH-IN WASTE LINES AND VENTS FOR BUILT-IN LAVATORIES

EVALUATION--Using the fixture manufacturer's specifications, rough-in the waste line and vent for a lavatory. The stubbed-out waste line must be within ± 1/2" of the manufacturer's specifications. Joints must not leak. Vent and drain lines must be properly graded and installed according to local codes.

I. Tools and equipment

  A. 6" rule or tape measure

  B. Pencil

  C. No-hub couplings

  D. Cast iron pipe cutter

  E. Torque wrench

  F. Galvanized steel pipe cutter

  G. Reamer

  H. Pipe threader

  I. Pipe compound or Teflon tape

  J. Pipe wrenches

  K. Electric saw

  L. Electric drilling machine with drills

  M. Hammer

  N. Chisel

  O. Nail puller

  P. Pipe

  Q. Fittings

  R. Roof flange

II. Procedure

  A. Lay out waste line from main line to fixture

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JOB SHEET #11

B. Measure and cut piping for rough-in plumbing

C. Assemble piping, using no-hub couplings

D. Attach 2" X 1 1/2" sanitary tee to assembly end

E. Join 1 1/2" galvanized pipe, using tapped tee for connection

F. Align and support pipe

G. Run vent line from soil pipe to revent line or through roof

H. Check with instructor for approval of job

I. Clean up the area and return all tools and equipment

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DRAINAGE SYSTEMS
UNIT II

JOB SHEET #12–ROUGH-IN WASTE LINES AND VENTS FOR BATHTUBS

EVALUATION–Using the fixture manufacturer's specifications and needed tools and supplies, rough-in the waste lines and vent for a bathtub. Finished work must be approved by the instructor using a checklist.

I. Tools and equipment

- A. Rough-in book
- B. 6' rule or steel tape
- C. P.V.C. pipe
- D. Fittings
- E. Hand saw
- F. P.V.C. cement and cleaner
- G. Pipe hangers
- H. Hammer
- I. Blueprints

II. Procedure

- A. Take measurements from rough-in specifications
- B. Lay out waste line from main line or from foundation wall to fixture
- C. Cut pipe to length
- D. Assemble pipe, leaving cleanout and vent openings as necessary
- E. Align and support pipe
- F. Insert foam cup for waste line at tub drain, if installing waste in concrete slab
- G. Run vent line from soil pipe to revent line, or through roof
- H. Check with instructor for approval of job
- I. Clean up the area and return all tools and equipment

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1p

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write YES in the space provided. If the performance is unsatisfactory, write NO in the space. Each item must be rated "yes" for satisfactory task performance.

1. Waste line was vented according to code. ___

2. Cleanout plugs were properly located. ___

3. Pipes were properly aligned and supported. ___

4. Proper pipe materials and fittings were used. ___

5. Joints did not leak when tested. ___

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JOB SHEET #13–SECURE WITH HANGERS HORIZONTAL AND VERTICAL LINES OF PIPE TO MASONRY SURFACES

EVALUATION–Given an assortment of hangers, necessary tools and equipment, and lengths of pipe of different kinds and sizes, hang one pipe horizontally and one vertically to a masonry surface. The correct hanger must be chosen for the selected pipe. Instructor must approve job.

I. Tools and equipment

   A. Hangers

   B. Threaded rod

   C. Screws

   D. Bolts and nuts

   E. Safety glasses

   F. Molly bolts

   G. Hammer

   H. Electric drilling machine

   I. Drills

   J. Adjustable wrench

   K. Hacksaw

   L. Pipe

II. Procedure

   A. Select pipe, position, and needed hanger

   B. Locate hanger points on surface

   C. Prepare surface (if needed)

   D. Secure hanger or hanger section (which ever needed) to surface

   E. Attach hanger clamp portion to pipe (if needed)

   F. Hoist pipe into position for hanger acceptance

   G. Secure pipe to hanger

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H. Check with instructor for approval of job

I. Clean up area and return tools and equipment

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JOB SHEET #14--SECURE WITH HANGERS HORIZONTAL AND VERTICAL LINES OF PIPE TO WOOD SURFACES

EVALUATION--Given an assortment of hangers, necessary tools and equipment, and lengths of pipe of different kinds and sizes, hang one pipe horizontally and one vertically to a wood surface. The correct hanger must be chosen for the selected pipe. Work must be approved by the instructor using a checklist.

I. Tools and equipment

   A. Hangers

   B. Threaded rod

   C. Screws, lag bolts

   D. Bolts and nuts

   E. Safety glasses

   F. Hammer

   G. Screwdriver

   H. Adjustable wrench

   I. Electric drilling machine

   J. Drills

   K. Hacksaw

   L. Pipe

II. Procedure

   A. Select pipe, position, and needed hanger

   B. Locate hanger points on surface

   C. Prepare surface (if needed)

   D. Secure hanger or hanger section (whichever needed) to surface

   E. Attach hanger clamp portion to pipe (if needed)

   F. Hoist pipe into position for hanger acceptance

   G. Secure pipe to hanger

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H. Check with instructor for approval of job

I. Clean up the area and return all tools and equipment

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write YES in the space provided. If the performance is unsatisfactory, write NO in the space. Each item must be rated "yes" for satisfactory task performance.

1. Were hangers properly selected for each pipe and working surface? ___
2. Were hangers affixed correctly? ___
3. Are vertical pipes secured at 90° to the floor surface? ___
4. Are overhead pipes at proper angle to the floor surface? ___
5. Are distances between hangers correct for pipe used? ___
6. Is the pipe or tubing secure? ___
7. Is work neatly done? ___
8. Does installation comply with local codes? ___

JOB SHEET #15–SECURE WITH HANGERS HORIZONTAL AND VERTICAL LINES OF PIPE TO METAL SURFACES

EVALUATION–Given an assortment of hangers, necessary tools and equipment, and lengths of pipe of different kinds and sizes, hang one pipe horizontally and one vertically to a metal surface. The correct hanger must be chosen for the selected pipe. Instructor must approve job.

I. Tools and equipment

   A. Hangers

   B. Threaded rod

   C. Screws

   D. Nut and bolts

   E. Safety glasses

   F. Molly bolts

   G. Clamps

   H. Hammer

   I. Adjustable wrench

   J. Electric drilling machine

   K. Drills

   L. Hacksaw

   M. Pipe

II. Procedure

   A. Select pipe, position, and needed hanger

   B. Locate hanger points on surface

   C. Prepare surface (if needed)

   D. Secure hanger or hanger section (whichever needed) to surface

   E. Attach hanger clamp portion to pipe (if needed)

   F. Hoist pipe into position for hanger acceptance

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G. Secure pipe to hanger

H. Check with instructor for approval of job

I. Clean up the area and return all tools and equipment

DRAINAGE SYSTEMS
UNIT I

JOB SHEET #16–INSTALL VENT TERMINALS (ROOF FLASHING)

EVALUATION–Given a lead hammer and a cast iron main vent pipe, install a vent terminal on the vent pipe. The terminal must be watertight.

I. Tools and equipment

  A. Lead hammer

  B. Vent terminal (roof flashing)

  C. Tar compound

  D. Putty knife

II. Procedure

  A. Select vent terminal to match pitch of roof

  B. Slip vent terminal over vent pipe extending through roof

  C. Depending on type vent terminal, bend terminal top over vent pipe, or beat lead top of terminal into cast-iron vent pipe to seal terminal

  D. Seal flashing with tar compound

  E. Check with instructor for approval of job

  F. Clean up the area and return tools and equipment

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JOB SHEET #17--INSPECT A PLUMBING SYSTEM

EVALUATION--Given a set of blueprints and building specifications, inspect a roughed-in plumbing system for compliance with the contract. Inspection must cover the sized of piping, insulation of piping, drain line grading, and vent line sizing and location. Any violation findings must correspond to the findings of the building inspector.

I. Tools and equipment

- A. Copy of contract
- B. Code book
- C. Pencil
- D. Notebook

II. Procedure

- A. Read the contract, especially the specifications
- B. Inspect the piping
- C. Check code book for compliance
- D. Write positive or negative report on inspection

  (NOTE: Be able to relate negative reports to code book regulation.)
- E. Give the report to the instructor
- F. Check with instructor for approval of job
- G. Return all materials to their correct places

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DRAINAGE SYSTEMS
UNIT I

NAME______________________________

TEST

1. Match the terms on the right to the correct definitions.

_____a. Drain, waste, and vent

_____b. Slope or grade given to a horizontal run of pipe to permit gravity flow of liquid

_____c. Pipe which carries waste water

_____d. Access point to drain or trap for the purpose of removing obstructions

_____e. Shield that fits over vent pipe on roof to prevent water from entering house through roof opening

_____f. Creating a partial vacuum in a pipe so that water can be drawn into it

_____g. Pipe which connects water closets to building drain and extends up out of house roof to serve as a vent

_____h. Initial stages of plumbing installation which include bringing the water and sewer lines into the building and topping-out or installing all pipes which will be enclosed in the walls

_____i. The vertical extension of the drainage system through the roof and all that piping above the highest horizontal drain which is connected to the stack

1. Flashing
2. Pitch
3. Rough-in
4. Soil stack
5. Syphoning
6. D.W.V.
7. Vent stack
8. Cleanout
9. Drain pipe

3. Distinguish between materials used in soil pipes and materials used in waste pipes by placing an "X" next to the materials used for soil pipes and an "O" next to the materials used for waste pipes. Materials may be used for both types of pipes.

_____a. Cast iron

_____b. Copper

_____c. Plastic

_____d. Galvanized steel

4. State the functions of soil, waste, and vent pipes.

a. Soil--

b. Waste--

c. Vent--

1)

2)

3)

5. State two purposes of plumbing traps.

a.

b.

6. Select types of traps by placing an "X" in the appropriate blanks.

_____a. P-trap

_____b. T-trap

_____c. A-trap

_____d. S-trap

_____e. Running trap

_____f. Gun trap

_____g. Drum trap

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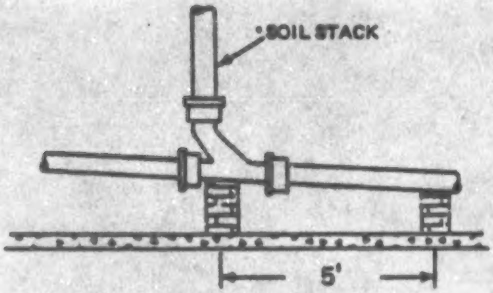
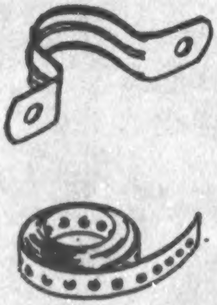
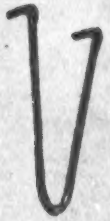
7. Identify various types of pipe hangers, clamps, and supports.



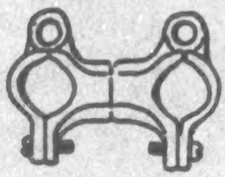
a ____________________



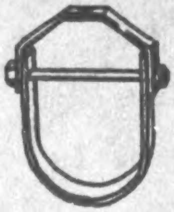
b ____________________



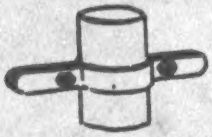
c ____________________



d ____________________



e ____________________



f ____________________

8. Match pipe hangers, clamps, and supports on the right to their uses.

_____a. Supports base of stack and horizontal runs of large pipe near floor or ground level

_____b. Supports small size pipes by attaching to walls, beams, and ceilings

_____c. Supports small to medium size pipes to wooden beams and joists

_____d. Supports small to medium size pipes to any kind of ceiling or wall structure

_____e. Supports medium to large size pipes to ceiling or wall structure

_____f. Supports stacks and other large pipe when additional vertical support is needed

1. Wire hook
2. Clevis hanger
3. Pipe clamp
4. Pier
5. Riser clamp
6. Straps

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9. Distinguish between the location, materials, and functions of building sewers and storm drains by placing an "X" next to items related to storm drains.

_____a. Located between building and sewer main

_____b. Made from cast iron, vitrified clay, plastic, or galvanized steel

_____c. Carries sewage from the building to the main sewer

_____d. Carries off rain water and other uncontaminated water in a system independent of the sewage system

_____e. Located in, under, and/or outside building

10. Discuss the installation of building sewers and storm drains.

a. Building sewers

b. Storm drains

11. List two steps used when adding new plumbing to an old system during each of the following stages.

a. Planning

1)

2)

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b. Roughing-in the drainage

1)

2)

c. Roughing-in water distribution pipes

1)

2)

12. Discuss the water and air methods of testing drainage systems for leaks.

a. Water

b. Air

13. Discuss trenching techniques.

a.

1)

2)

3)

4)

b.

1)

2)

14. Discuss shoring materials and devices.

a. Materials

1)

2)

3)

b. Devices

1)

2)

3)

15. Discuss five trenching hazards and their safety precautions.

a. Materials and tools falling into the trench

1)

2)

3)

4)

5)

6)

b. Excavated debris falling into the trench

1)

2)

c. Machinery falling into an excavation

1)

2)

3)

d. Debris falling from working machinery

1)

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        2)

    e. Machinery hitting power or utility lines

        1)

        2)

    f. People falling into an open trench

        1)

        2)

        3)

        4)

16. Label a cross section of a P-trap.

17. Identify fittings required on a drainage system.

18. Demonstrate the ability to:

    a. Install a bathtub waste and overflow and trap on a two story building.

    b. Install a prefabricated shower base drain (caulked method).

    c. Lay out trench lines.

    d. Calculate the slope required for building sewer lines.

    e. Install drain pipe in trenches.

    f. Install storm drains.

    g. Backfill trenches.

    h. Install pipe sleeves or thimbles through walls, ceilings, or floors.

    i. Install soil or waste back vents.

    j. Install cleanouts on drains.

    k. Rough-in waste lines and vents built-in lavatories.

    l. Rough-in waste lines and vents for bathtubs.

    m. Secure with hangers horizontal and vertical lines of pipe to masonry surfaces.

    n. Secure with hangers horizontal and vertical lines of pipe to wood surfaces.

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o. Secure with hangers horizontal and vertical lines of pipe to metal surfaces.

p. Inspect a plumbing system.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

DRAINAGE SYSTEMS
UNIT I

ANSWERS TO TEST

1. a. 6
   b. 2
   c. 9
   d. 8
   e. 1
   f. 5
   g. 4
   h. 3
   i. 7

2. a. City sewer
   b. Building sewer
   c. Cleanout
   d. Building drain (soil pipe)
   e. Building drain branch (waste pipe)
   f. Stack cleanout
   g. Waste stack (waste pipe)
   h. Soil stack (soil pipe)
   i. Vent stack (vent pipe)
   j. Stack vent (vent pipe)
   k. Horizontal branch (waste pipe)
   l. Fixture drain (waste pipe)
   m. Fixture trap
   n. Individual vent (vent pipe)
   o. Branch vent (vent pipe)
   p. Roof flashing

3. a. X O
   b. X O
   c. X O
   d. O

4. a. Soil pipes carry drainage which includes fecal matter (toilet discharge)

   b. Waste pipes carry liquid waste which do not contain fecal matter (toilet discharge)

   c. 1) Vent pipes allow free air to circulate in the system as the "vent" or terminal is open to the atmosphere above the building roof

      2) Vent pipes provide equalization of air pressure on both sides of the fixture trap, thus preventing the syphoning of the trap

      3) Vent pipes minimize back pressure on trap seals thus preventing loss of seal

5. Any two of the following:

   a. Provides a liquid seal which will prevent the back passage of air without affecting the flow of sewage or waste water through it

   b. Prevents sewer gas from entering the building through the fixture

   c. Prevents vermin from entering the building through the fixture

6. a, d, e, g

7. a. Pier

   b. Strap

   c. Pipe hook

   d. Pipe clamp

   e. Clevis hanger

   f. Riser clamp

8. a. 4 d. 3

   b. 6 e. 2

   c. 1 f. 5

9. b, d, e

10. Discussion should include:

    a. Building sewers

       1) Excavation of trench should be clean and neat

       2) Pipe should be laid alongside trench for easy access

       3) Trench should be graded or given pitch to allow for gravity drainage of sewer pipe

       4) In some instances, a "lateral" is provided by the city and the plumber must first establish the actual depth of this lateral

- b. Storm drains
    - 1) Usually not trapped
    - 2) Extended drain pipe might be perforated to disperse water into ground
    - 3) Drain pipe might empty into:
        - a. Dry well
        - b. Lake, pond, or stream
    - 4) Drain pipe around foundations are perforated to collect and carry seepage water away from building

11. Any two under each stage:
    - a. Planning
        - 1) Check local plumbing code
        - 2) Determine location and design
        - 3) Determine availability of existing plumbing
        - 4) Develop material list
    - b. Roughing-in the drainage
        - 1) Determine layout of new fixtures
        - 2) Cut out access holes and openings for new pipe installation
        - 3) Cut into the existing drainage system
        - 4) Install drainage pipes
    - c. Roughing-in water distribution pipes
        - 1) Cut into existing water system
        - 2) Cut and/or drill access holes and openings for new pipe installation
        - 3) Install water distribution pipes

12. Discussion should include:
    - a. Water
        - 1) If entire system is tested, fill the system until water overflows the vent stack above the roof
        - 2) If sections of the system are tested, a 10' head must be applied to the tested section

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    3) Allow water to remain in system for 15 minutes prior to the test

    4) Visually inspect all joints of the tested system

    5) If no leaks are found, the system is tight at all joints

  b. Air

    1) Attach air compressor testing apparatus to any suitable opening

    2) Close all other inlets and outlets

    3) Test system by maintaining 5 pounds per square inch pressure for 15 minutes

13. Discussion should include:

  a. Open trenching

    1) Angle of repose must be adequate

    2) Depends on type of soil

    3) Demands careful attention to slope

    4) Open trenching is acceptable only when soil type and space permit a safe angle of repose

  b. Shored trenching

    1) Always use proper shoring in potentially dangerous excavations

    2) Federal (O.S.H.A.) standards require shoring where excavation walls exceed a depth of four feet, and trenches must have a ladder for every 25 feet of lateral

14. Discussion should include:

  a. Materials

    1) Timber bracing--Wooden stanchions placed at intervals and supported by wooden braces

    2) Light timber sheeting--Continuous, tightly arranged wooden stanchions held by wooden cross members

    3) Sheet piling--A pile or sheeting that forms a continuous support wall, or a row of timber, concrete, or steel piling driven to assure a tight supporting wall against earth pressure

  b. Devices

    1) Trench box--A continuous supportive box of wood and/or metallic supports to retain the earth

    2) Hydraulic shores--Hydraulic jacks, usually made of aluminum, activated by a hydraulic pump

3) Screw jacks--Metallic screw devices with foot supports on both edges; they hold timbers or boards against the trench face

15. Discussion should include any five of the following:

a. Materials and tools falling into the trench

1) All pipes or tools used on the job should be placed at least two feet from the edge of a trench

2) All workers should wear hard hats to protect themselves from debris or tools accidentally dropped in the trench

3) Pipe should be handed carefully into a trench, not dropped or rolled

4) Heavy tools and pipe should be handled by two or more workers to avoid heavy materials getting out of control

5) Move pipe and equipment only as required

6) Never stack materials by the edge of a trench or any excavation

b. Excavated debris falling into the trench

1) Earth, rocks, or other materials removed from the trench should be placed at least two feet from the edge

2) Avoid piling excavated materials too high since this could overload the trench wall and create a potential cave in

c. Machinery falling into an excavation

1) Beware of operating equipment at all times and maintain a safe distance

2) If operating equipment vibrates excessively, notify a foreman; this vibration could be transmitted through soil to the trench wall and cause a cave in

3) Note any careless or unskilled machine operators and suggest to the appropriate foreman that the situation be corrected

d. Debris falling from working machinery

1) Wear a hard hat for all trenching operations

2) Wear goggles anytime there is a potential for flying debris

e. Machinery hitting power or utility lines

1) Locate and mark underground obstacles: water, gas, telephone, electric, and steam lines, storm drains, sprinklers, and other equipment piping

2) Locate and mark overhead obstacles: power, lighting and telephone lines and trees or man made obstacles

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f. People falling into an open trench

1) Secure the job site at all times, especially at night, keeping in mind that curious children find job sites an interesting playground.

2) Cover all open trenches with timber or plywood strong enough to support a reasonable amount of weight

3) Position the protective sheathing so it will not only protect the public from danger but serve to shield the trench from rain water

4) Reflective barricades and lights around the trench add additional protection for both curious passersby and animals

16. Evaluated to the satisfaction of the instructor.

17. Evaluated to the satisfaction of the instructor.

18. Performance skills evaluated to the satisfaction of the instructor.

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WATER SYSTEMS
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify the components of a residential water system, and describe methods of testing water systems. The student should also be able to demonstrate the ability to make an isometric drawing and determine pipe sizes for a hot and cold water system. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVE

After completion of this unit, the student should be able to:

1. Match terms associated with residential water systems to the correct definitions or descriptions.
2. Identify components of a water system in a single-family dwelling.
3. Match the components of a water system in a single-family dwelling to the correct functions.
4. Select factors to consider when installing a hot water system.
5. Select true statements about sizing of pipes in residential water systems.
6. Distinguish between materials used for pipes and materials used for valves in water pipe systems.
7. Select true statements about the prevention of frozen pipes in cold weather.
8. List two methods of preventing contamination of water systems by cross connections.
9. Describe two methods of testing a water system for leaks.
10. Make an isometric drawing of a hot and cold water system for a two-story house.
11. Determine pipe sizes for a hot and cold water system for a two-story house.
12. Demonstrate the ability to:
    a. Rough-in water supply lines for bathtubs.
    b. Rough-in water supply lines for water closets.
    c. Rough-in water supply lines for water heaters.
    d. Make water pressure tests on water supply systems.

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WATER SYSTEMS
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide student with objective sheet.
- B. Provide student with information, assignment, and job sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information and assignment sheets.
- F. Demonstrate and discuss the procedures outlined on the job sheets.
- G. Take class on a field trip to a construction site.

  (NOTE: Make previous arrangements with plumbing contractors.)
- H. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete assignment and job sheets.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
  1. TM 1--Components of a Residential Water System
  2. TM 2--Components of a Residential Water System (Continued)
  3. TM 3--Water Hammer Arrestors
  4. TM 4--Inlet and Outlet Pipe Sizing

5. TM 5--Sizing of Pipe

6. TM 6--Sizing of Pipe (Continued)

7. TM 7--Prevention of Frozen Pipes

8. TM 8--Methods of Preventing Water Contamination

9. TM 9--How Water is Contaminated

D. Assignment sheets

1. Assignment Sheet #1--Make an Isometric Drawing of a Hot and Cold Water System for a Two-Story House

2. Assignment Sheet #2--Determine Pipe Sizes for a Hot and Cold Water System for a Two-Story House

E. Answers to assignment sheets

F. Job sheets

1. Job Sheet #1--Rough-in Water Supply Lines for Bathtubs

2. Job Sheet #2--Rough-in Water Supply Lines for Water Closets

3. Job Sheet #3--Rough-in Water Supply Lines for Water Heaters

4. Job Sheet #4--Make Water Pressure Tests on Water Supply Systems

G. Test

H. Answers to test

II. References:

A. *National Plumbing Code Illustrated.* St. Petersburg, Fla.: Manas Publications, 1973.

B. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, IL: Goodheart-Willcox, 1978.

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WATER SYSTEMS
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Cross connection--Any link between contaminated water and potable water in the water system

   B. Potable water--Water which is satisfactory for drinking and domestic purposes

   C. Frost line--The depth of frost penetration in the soil

   (NOTE: Water pipes should be installed below the depth. In northern climates, the service pipe is buried as much as 7 feet or more deep in the ground.)

   D. Pressure head--Amount of force or pressure created by the depth of one foot of water

   E. Sill cock--A faucet on the outside of the building to which a garden hose can be attached

   F. Shut-off valve--A full opening valve installed in the water line wherever a cut-off is required

   G. Friction loss--Flow pressure loss caused by liquid coming in contact with the inside of the pipe

II. Components of a water system in a single-family dwelling (Transparencies 1 and 2)

   A. Water main (city main)

   B. Corporation coupling and valve

   C. Curb stop valve

   D. Curb box

   E. Service pipe

   F. Water meter

   G. Water meter stop valves

   H. Main water line

   I. Distribution pipes

   J. Riser pipes

INFORMATION SHEET

K. Air chambers

L. Water heater

M. Water conditioner (optional)

III. Components and functions

A. Water main--A large pipe, buried in the street, which distributes water throughout the town or city

B. Service pipe–Water pipe which supplies water from the water main or other source of supply to the building served

C. Water meter–Records amount of water consumed by residence or dwelling

(NOTE: In northern climates, the meter is installed in the basement or utility room.)

D. Curb stop–A valve placed in the service line at or near the curb which permits easy control over the system

E. Curb box--A cylindrical casting placed over the curb stop to allow remote opening and closing of the stop

F. Distribution pipes–Pipes which carry water from the service pipe to fixtures in the building

G. Meter stop–A valve installed between the street and the water meter

H. Riser pipes--Pipes which rise vertically from a horizontal pipe

I. Shut-off valve–A valve installed in the water line wherever a cut-off is required

J. Air chamber–A closed section of pipe or coil, or a patented device designed to absorb shock caused by a rapidly closing valve or faucet; this prevents water-hammer and is installed at time of roughing in (Transparency 3)

K. Corporation stop--A valve installed in the service pipe at the water main

IV. Factors to consider when installing a hot water system

(NOTE: Refer to local codes.)

A. Water heater is located according to

1. Source of cold water supply
2. Source of fuel supply
3. Access to fuel exhaust if necessary

INFORMATION SHEET

B. Main hot water pipe should be equal in size to the main cold water pipe

C. Inlet pipe to the water heater must be at least as large as the outlet pipe (Transparency 4)

D. Hot water distribution pipes are equal in sizing and design to the cold water distribution pipe (Transparency 4)

V. Sizing of pipes in residential water systems (Transparencies 5 and 6)

A. Most town or city water supplies are disbursed from elevated tanks which distribute the water by gravity

B. Water pressure increases as the height of the water increases

C. A 1' column of water will create .433 lbs. per sq. inch of pressure at the base of the column

(NOTE: Width of the column has no effect on the pressure.)

D. Distribution pipes vary in size according to their fixture application

E. Rule of thumb for distribution pipe sizes are:

1. Up to three 3/8" branches can be supplied by a 1/2" pipe
2. Up to three 1/2" branches can be supplied by a 3/4" pipe
3. Up to three 3/4" branches can be supplied by a 1" pipe

F. Water flow pressure is reduced by friction loss caused by the water coming in contact with the inside of the pipe

(NOTE: In long runs of pipe, consult charts for possible excessive friction loss.)

G. Number and type of fittings affect water pressure

(NOTE: Economical use of fittings will reduce cost and help reduce pressure loss.)

VI. Materials used in water pipe systems

A. Pipes

1. Copper
2. Plastic
3. Galvanized iron

(NOTE: Plastic pipe for hot water is still in the experimental stage.)

B. Valves

1. Brass

2. Plastic

3. Galvanized iron

(NOTE: Brass far outlasts any other type valve and therefore is more popular.)

VII. Prevention of frozen pipes in cold weather (Transparency 7)

A. Outside building pipe lines must be buried below frost line

(NOTE: Determine local conditions.)

B. Insulate pipes in crawl spaces

(NOTE: Grade pipes for drainage.)

C. Avoid installing pipes in outside walls

D. Install freeze-proof type hose bibs

E. If pipe is installed in an area subject to freezing, a drain valve must be installed

F. If in doubt, insulate or relocate pipes

(NOTE: An opposite situation can develop warm water in pipes if the pipes are too close to the surface and are affected by the heat of the sun.)

VIII. Methods of preventing contamination of water systems by cross connections (Transparencies 8 and 9)

A. Fixtures and fittings must be installed to provide an air-gap

(NOTE: Potable water systems must not inter-connect with other systems.)

B. Vacuum breakers must be provided where necessary

IX. Testing water systems for leaks

A. Water method

1. The test pressure should not be less than the pressure of the system to be used

2. Codes usually specify that water for these tests come from normal source of supply

   (NOTE: Some codes specify that only water tests are acceptable.)

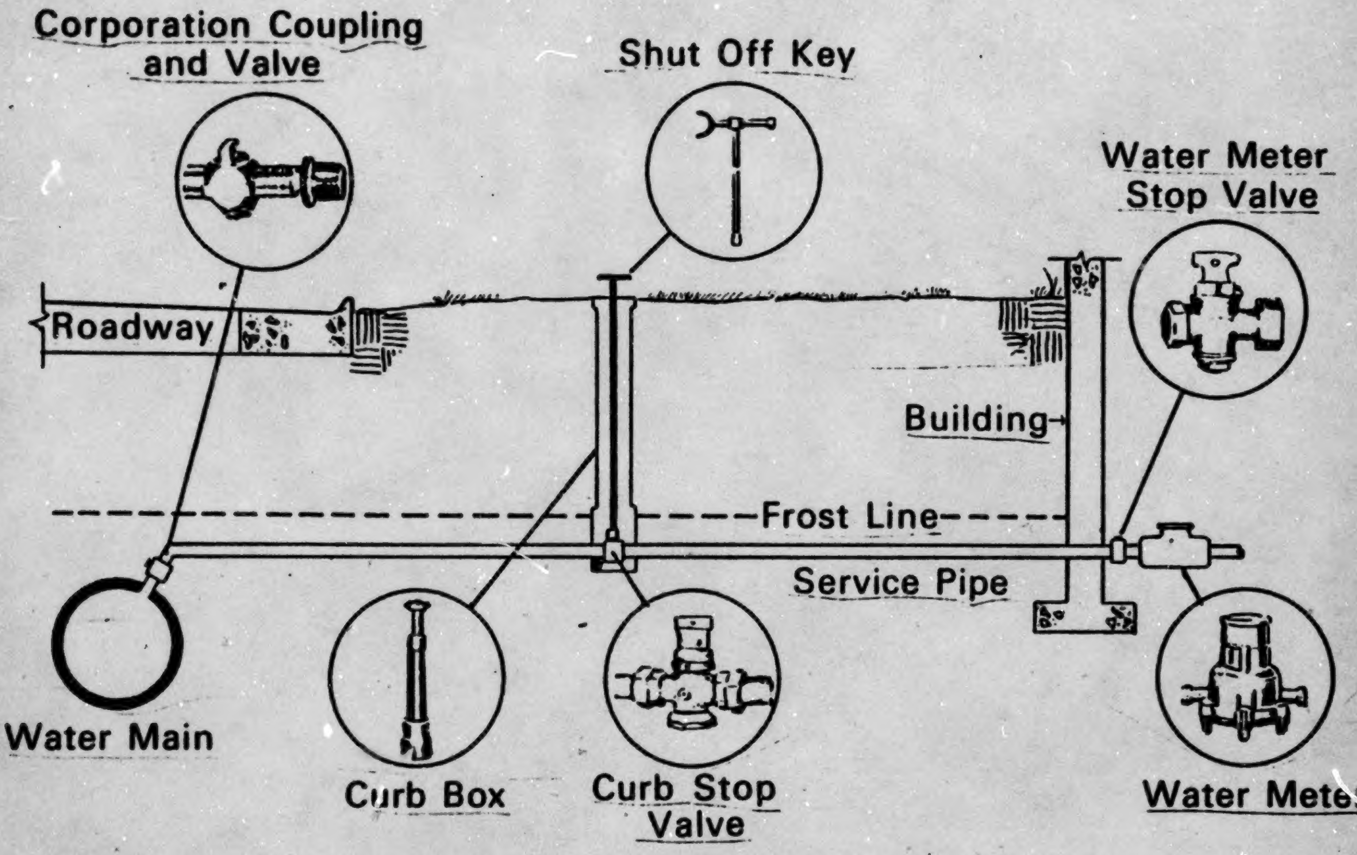
3. Testing from the normal source of supply requires that the plumbing installation be connected to the street main or to a neighboring residence

B. Air method

   1. Test pressure is usually 50 p.s.i. for 4 hours

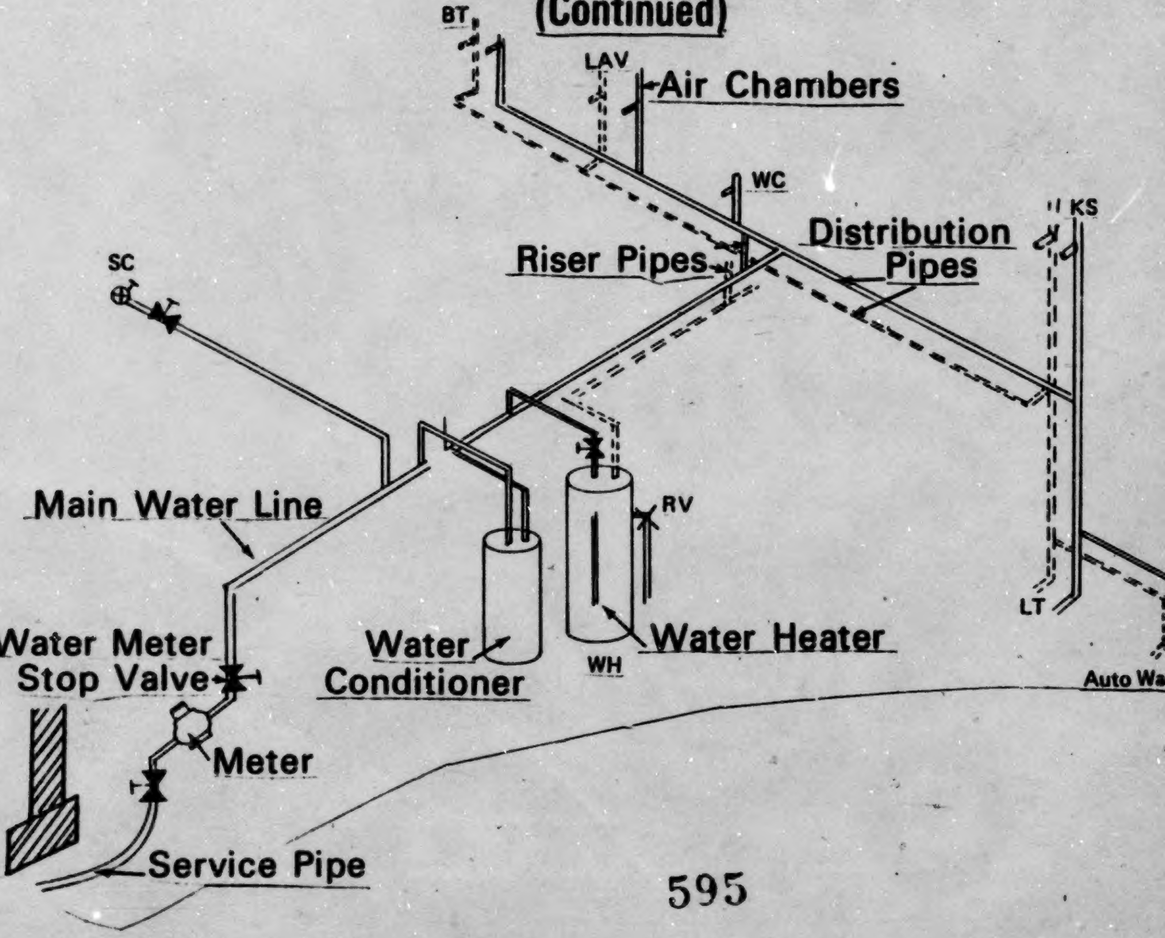
   2. Pressure gauge must be supplied and attached to piping installation by plumber

Components of a Residential Water System


Corporation Coupling and Valve
Shut Off Key
Water Meter Stop Valve
Roadway
Building
Frost Line
Service Pipe
Water Main
Curb Box
Curb Stop Valve
Water Mete

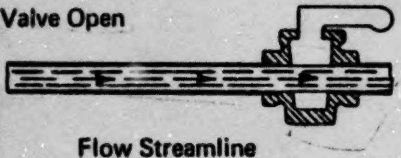
Components of a Residential Water System

(Continued)


BT
LAV
Air Chambers
WC
KS
Distribution Pipes
Riser Pipes
SC
Main Water Line
RV
Water Meter Stop Valve
Water Conditioner
Water Heater
WH
LT
Auto Wa
Meter
Service Pipe

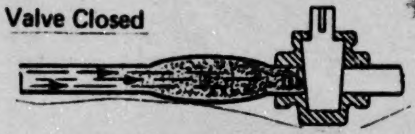
Water Hammer Arrestors

Valve Open



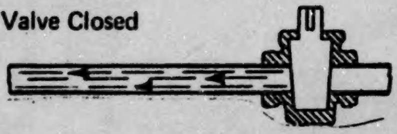
Flow Streamline

Valve Closed



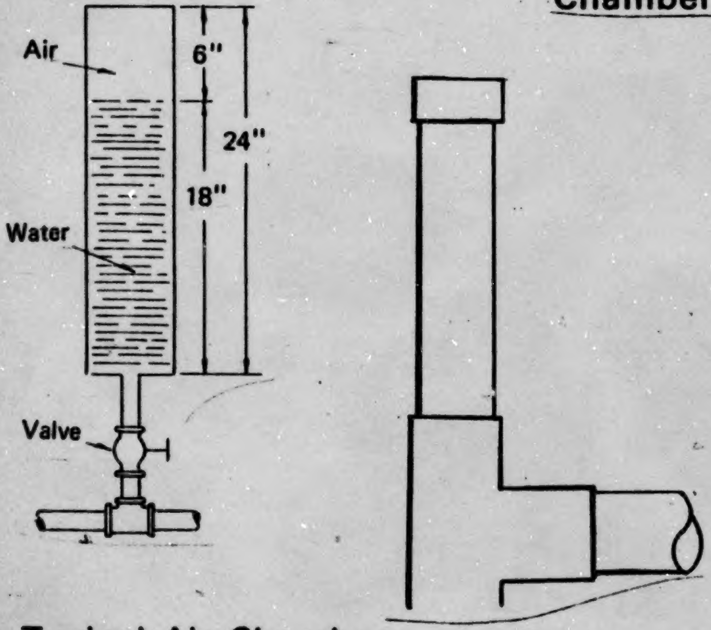
Increased Pressure Causes Pipe to Expand and Stretch Within 1/10 Second After Valve is Closed

Valve Closed

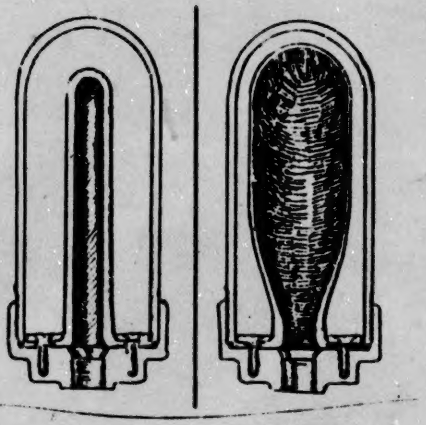


Pipe Returns to Its Original Shape and Size Forcing the Water in the Opposite Direction and Causing an Area of Reduc
Pressure Near the Valve. This Cycle is Repeated Until the Energy of The Movin
Water is Consumed by Friction.

Chamber Present

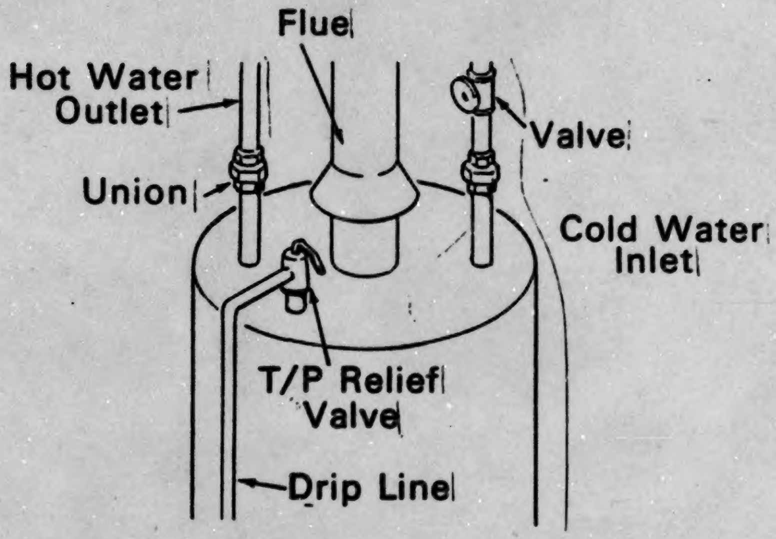


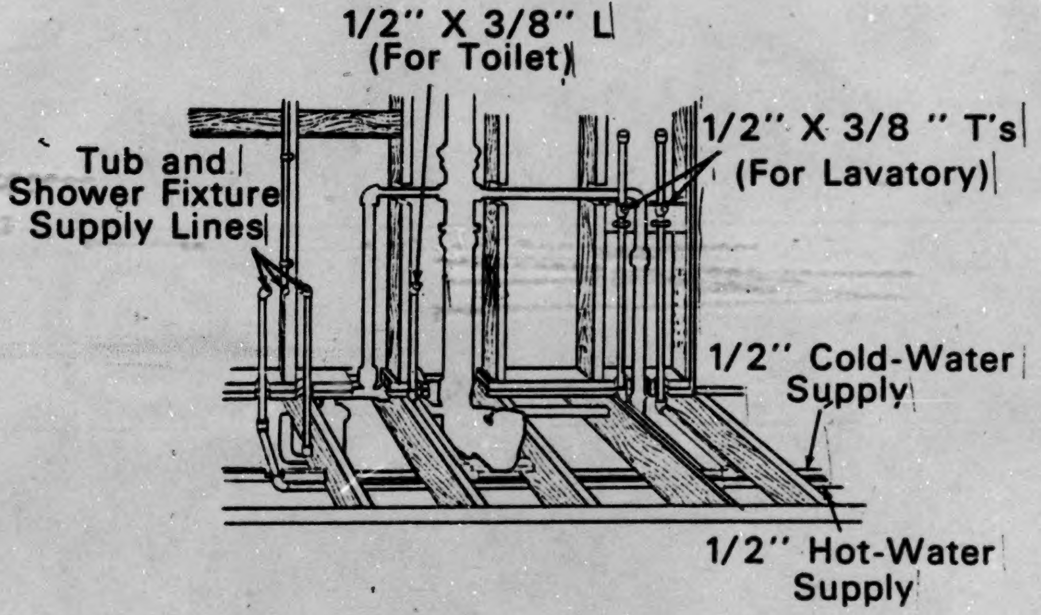
Typical Air Chamber
(Made from Pipe)



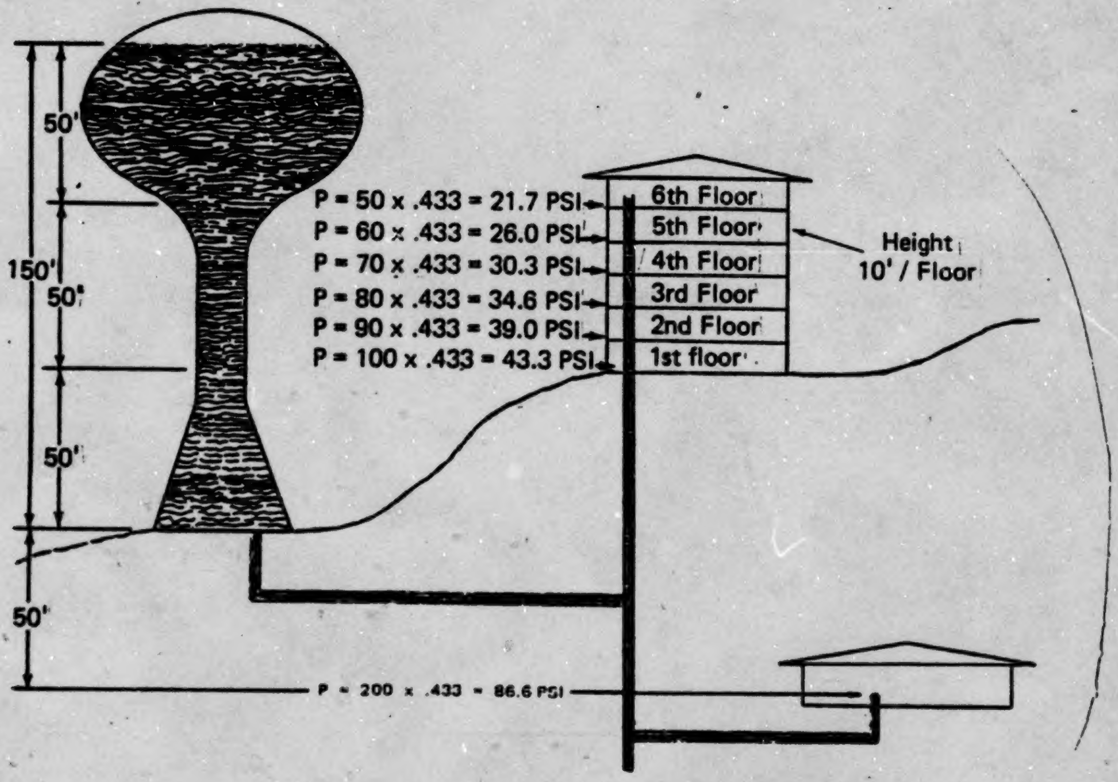
Patented Air Chambers

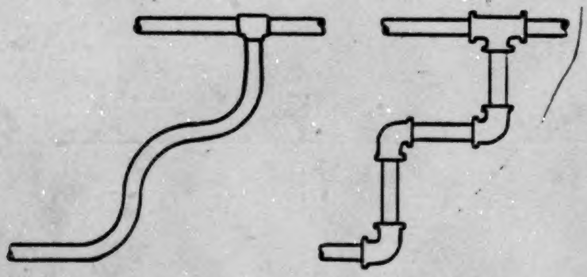
Inlet and Outlet Pipe Sizing


Flue
Hot Water Outlet
Valve
Union
Cold Water Inlet
T/P Relief Valve
Drip Line


1/2" X 3/8" L (For Toilet)
1/2" X 3/8 " T's (For Lavatory)
Tub and Shower Fixture Supply Lines
1/2" Cold-Water Supply
1/2" Hot-Water Supply

Sizing of Pipe

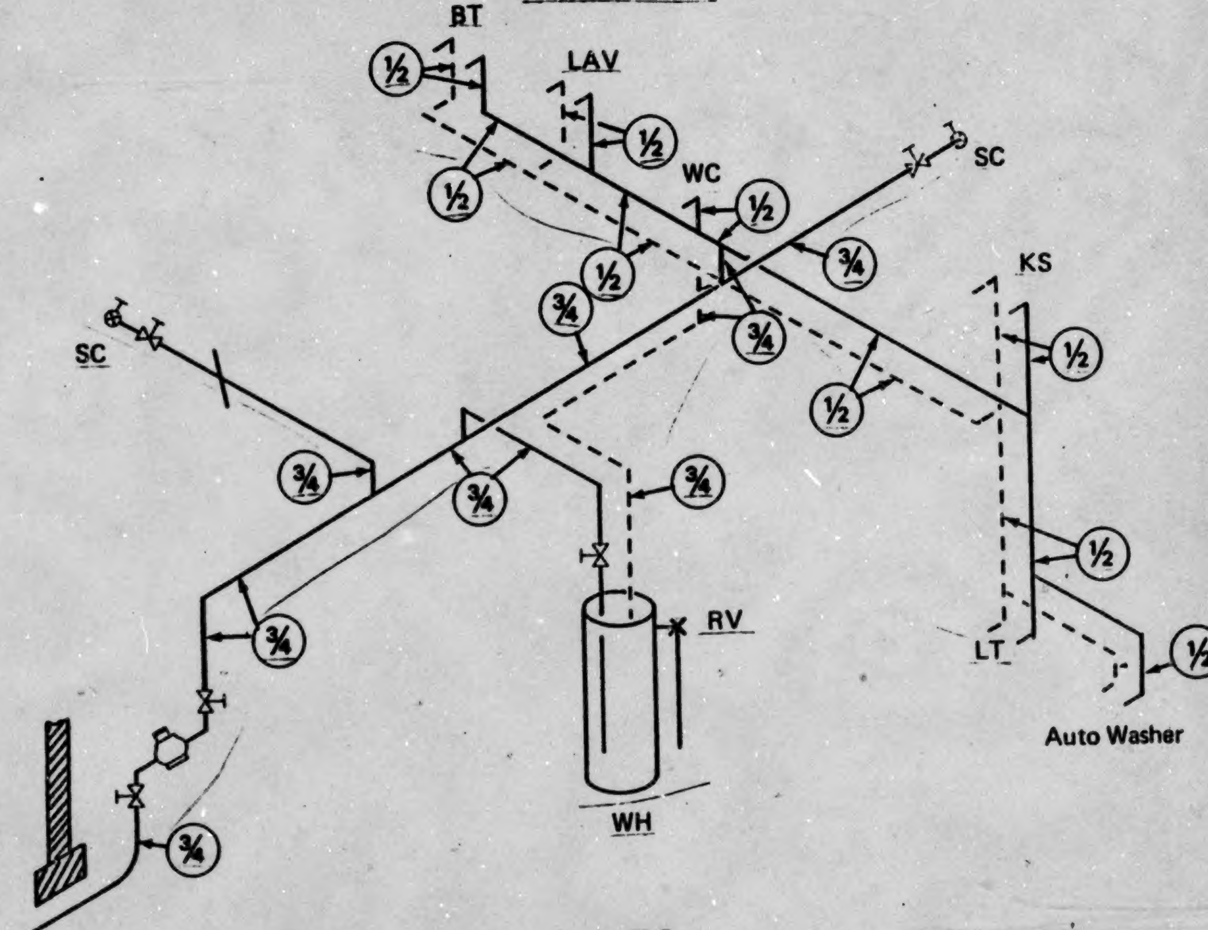

50'
150'
50'
50'
50'
P = 50 x .433 = 21.7 PSI
P = 60 x .433 = 26.0 PSI
P = 70 x .433 = 30.3 PSI
P = 80 x .433 = 34.6 PSI
P = 90 x .433 = 39.0 PSI
P = 100 x .433 = 43.3 PSI
6th Floor
5th Floor
4th Floor
3rd Floor
2nd Floor
1st floor
Height
10' / Floor
P = 200 x .433 = 86.6 PSI


Less Water
Flow Pressure
in This Pipe

Copper Tube Galvanized Iron

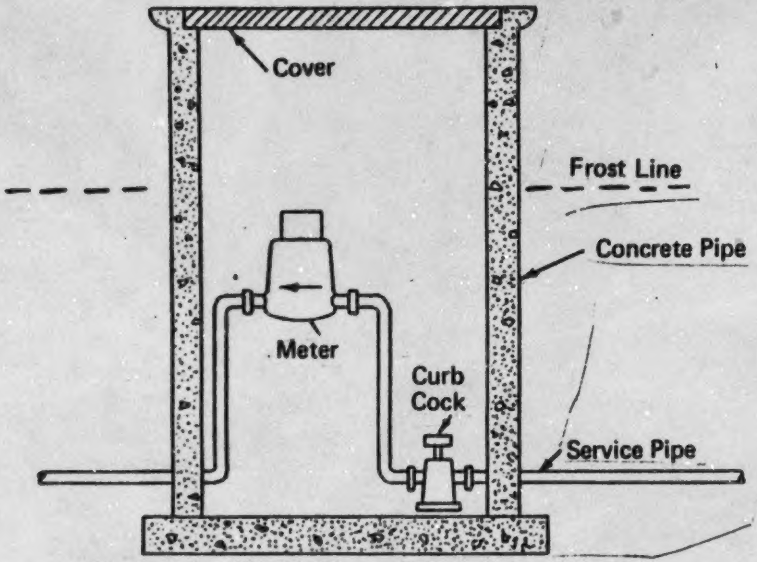
Sizing of Pipe

(Continued)

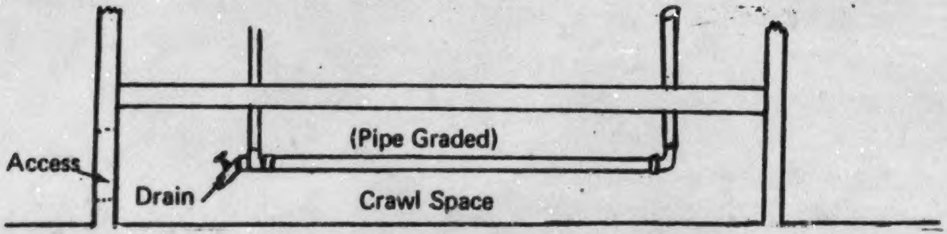


BT
½
LAV
½
½
WC
½
SC
½
¾
¾
KS
SC
¾
½
½
¾
¾
¾
½
RV
¾
LT
½
Auto Washer
WH
¾

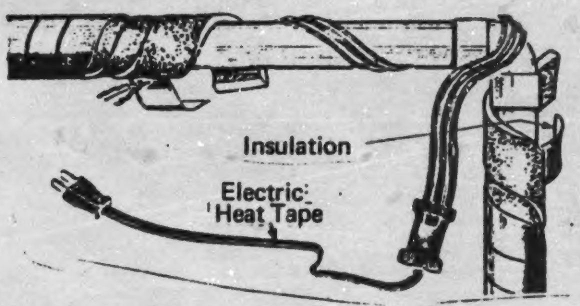
Prevention of Frozen Pipes


Cover
Frost Line
Concrete Pipe
Meter
Curb Cock
Service Pipe

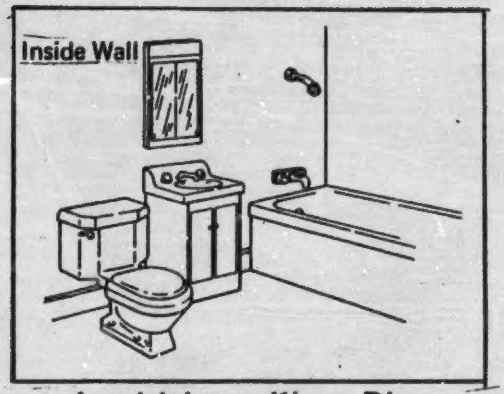
Outside Building Pipes Buried Below Frost Line


(Pipe Graded)
Access
Drain
Crawl Space

If Pipe is Installed in an Area Subject to Freezing, a Drain Valve Must Be Installed


Insulation
Electric Heat Tape

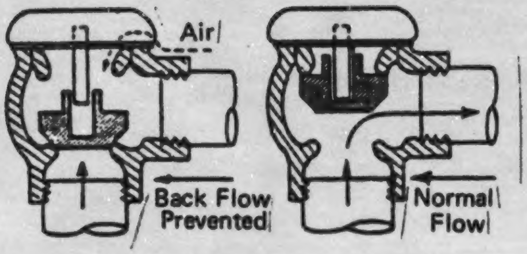
Insulate Pipes in Crawl Space


Inside Wall

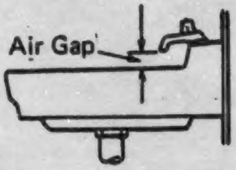
Avoid Installing Pipes in Outside Walls

Methods of Preventing Water Contamination

(Refer to Local Codes)

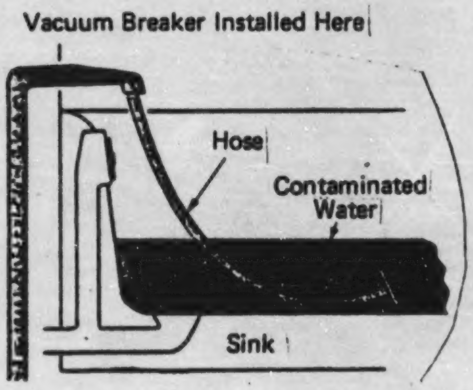

Air
Back Flow Prevented
Normal Flow

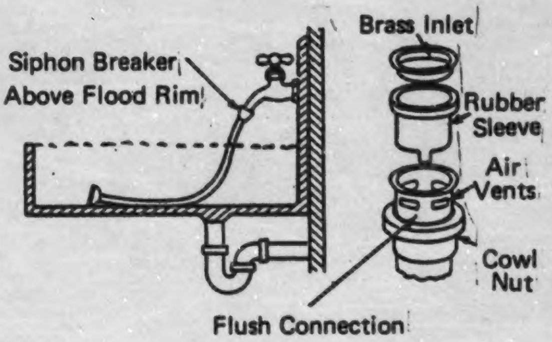
Vacuum Breaker



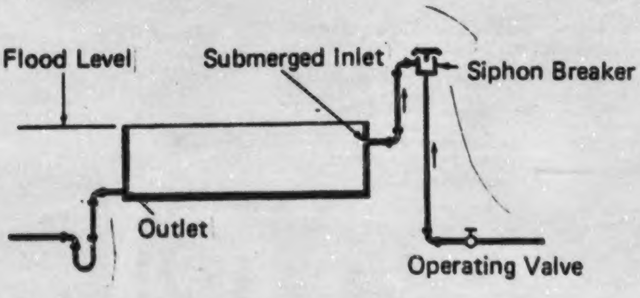
Fixture	Minimum Air Gap (Inches)
Lavatory	1
Sink and Laundry Tub	1 1/2
Bathtub	2

Sufficient Air Gap


Vacuum Breaker Installed Here
Hose
Contaminated Water
Sink

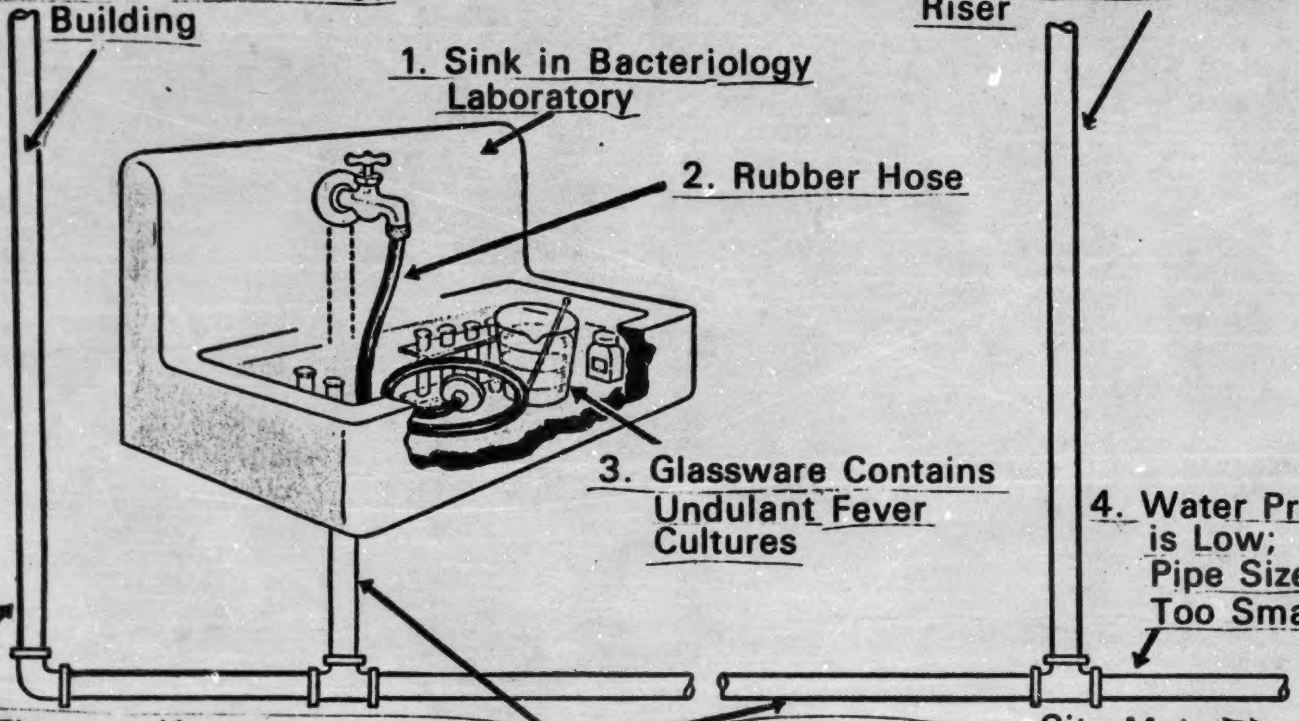

Siphon Breaker
Above Flood Rim
Brass Inlet
Rubber Sleeve
Air Vents
Cowl Nut
Flush Connection

Siphon Breaker


Flood Level
Submerged Inlet
Siphon Breaker
Outlet
Operating Valve

Typical Installation

How Water is Contaminated



7. Later, Water is Drawn on Upper Floor of Bacteriology Building

5. Water is Drawn in Nearby Building Supplied by This Riser

1. Sink in Bacteriology Laboratory

2. Rubber Hose

3. Glassware Contains Undulant Fever Cultures

4. Water Pressure is Low; Pipe Size Too Small

City Main ➛

8. Water Flows to Upper Floor Fixtures

6. Because of Low Pressure, Vacuum Forms Here When Water is Drawn in Nearby Building

WATER SYSTEMS
UNIT II

ASSIGNMENT SHEET #1--MAKE AN ISOMETRIC DRAWING OF A HOT AND COLD SYSTEM FOR A TWO-STORY HOUSE

Directions: Show the following components on an isometric drawing of a hot and cold water system for a two-story house.

A. Service pipe with valves

B. Meter with valves

C. Laundry tray connections

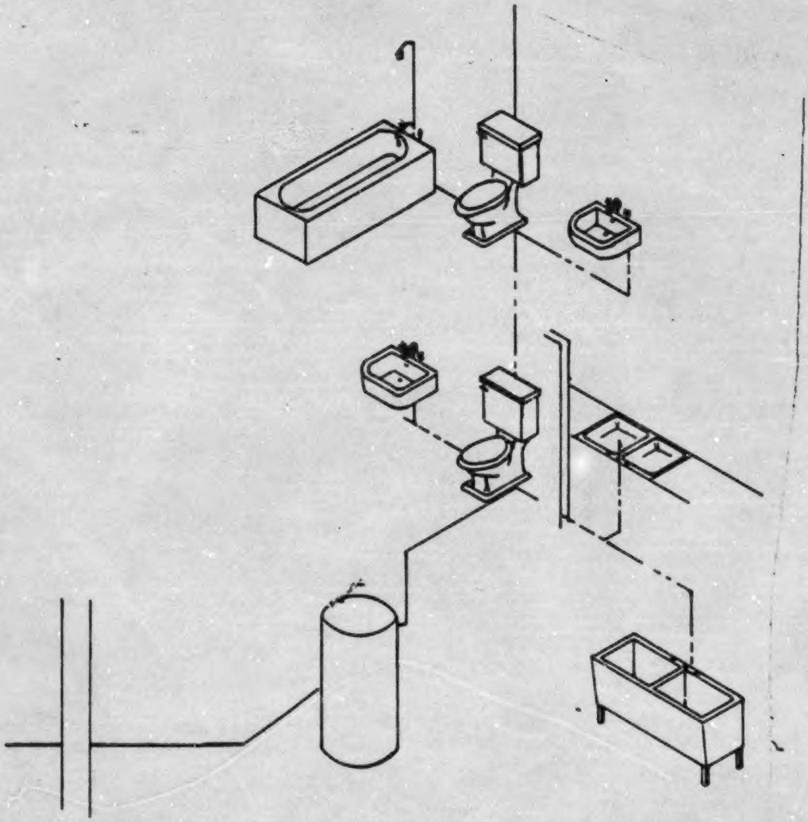
D. Water heater

E. Kitchen sink risers

F. Second floor bathroom risers

G. Bath, lavatory, and water closet distribution pipes

H. Air chambers for each bathroom fixture



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WATER SYSTEMS
UNIT II

ASSIGNMENT SHEET #2--DETERMINE PIPE SIZES FOR A HOT AND COLD WATER SYSTEM FOR A TWO-STORY HOUSE

Directions: Using the hot and cold water system developed in Assignment Sheet #1, determine the pipe sizes needed for that system. The service pipe is 3/4".

A. Service pipe is 3/4". 3/4"______

B. Meter ______________

C. Laundry tray ______________

D. Water heater ______________

E. Kitchen sink risers ______________

F. Second floor risers ______________

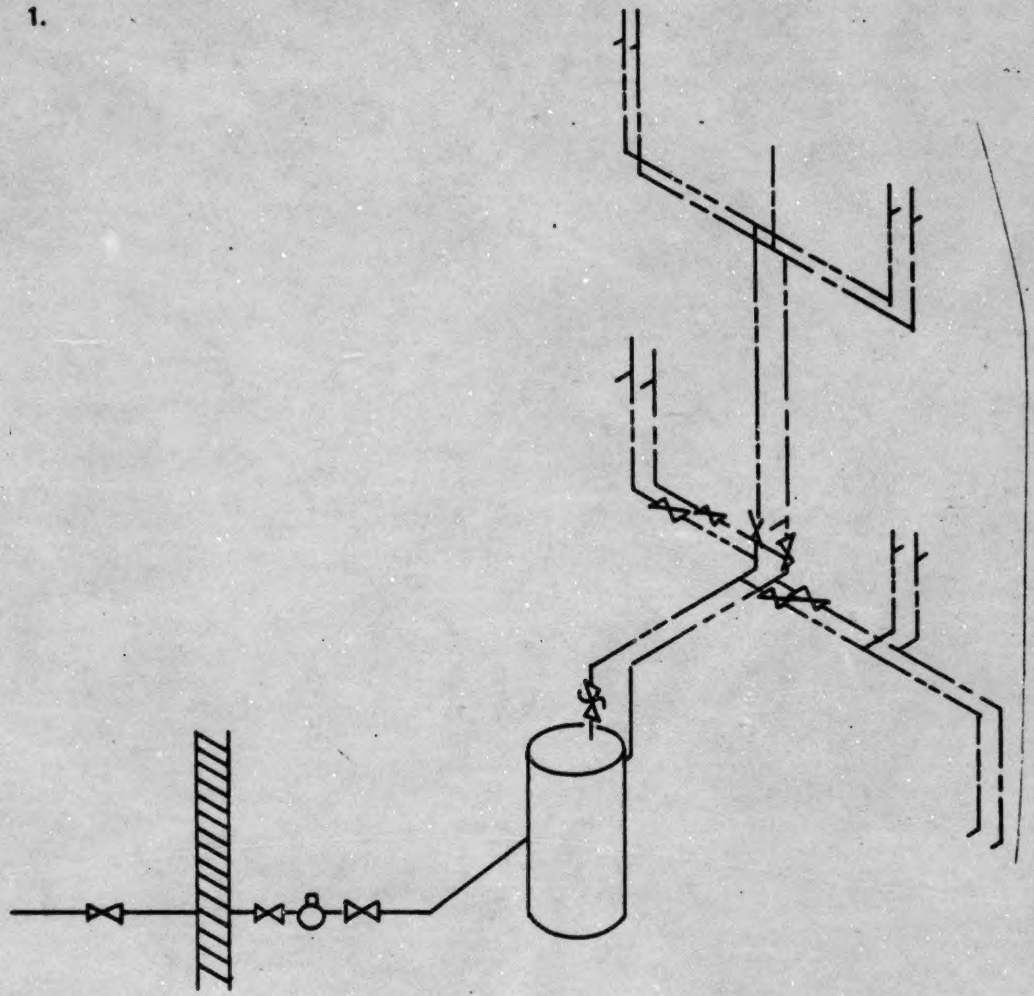
G. Second floor distribution pipe ______________

H. Air chambers ______________

WATER SYSTEMS
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

1.



2.				
a.	3/4"		e.	1/2"
b.	3/4"		f.	3/4"
c.	1/2"		g.	1/2"
d.	3/4"		h.	1/2"

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WATER SYSTEMS
UNIT II

JOB SHEET #1--ROUGH-IN WATER SUPPLY LINES FOR BATHTUBS

EVALUATION: Given a water supply line above or below a bathroom floor level, manufacturer's specifications, and access to plumbing tools, equipment and supplies, rough-in 1/2" diameter copper water supply lines for a shower, bath, and tub. The location of stubbed-out lines must be within ± 1/2" of the manufacturer's specifications.

I. Tools and equipment

- A. Soldering equipment
- B. Rough-in book
- C. Tubing
- D. Fittings and valves
- E. Bath-shower valve
- F. Pipe straps and nails
- G. 6' rule or steel tape
- H. Pencil
- I. Safety glasses

II. Procedure

- A. Cut in and solder tee on main hot and cold water lines
- B. Connect hot and cold water lines for tub and shower bath to main line tees
- C. Anchor over-rim filler valve in bath wall at proper height and depth
- D. Connect hot and cold water lines to shower-filler valve with cold water on right facing fixture
- E. Anchor and support tubing as necessary
- F. Solder and anchor shower arm riser
- G. Install shower arm
- H. Cap shower riser and diverter lines
- I. Check with instructor for evaluation of job

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JOB SHEET #2--ROUGH-IN WATER SUPPLY LINES FOR WATER CLOSETS

EVALUATION: Given a previously installed cold water line above or below the floor level, fixture manufacturer's rough-in specifications, and access to plumbing tools, equipment and supplies, rough-in a 1/2" diameter copper water supply line for a water closet. The stubbed-out supply lines must be located within ± 1/2" of the manufacturer's specifications. Joints must not leak.

I. Tools and equipment

   A. 6' rule or steel tape

   B. Pencil

   C. Rough-in book

   D. Soldering tools

   E. Tubing

   F. Fittings

   G. Air chamber

   H. Pipe straps and nails

   I. Hammer

   J. Drilling machine

   K. Drill

II. Procedure

   A. Mark location of water supply line on a wall

   (NOTE: Normally, supply line is roughed-in 6" left of center of fixture.)

   B. Solder tee on main water supply line, if necessary

   C. Connect fixture supply branch to main supply tee

   D. Install air chamber on fixture supply line, if required

   E. Install supply line out of wall at correct height from floor

   (NOTE: Normally, tubing should protrude 6" out of wall.)

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JOB SHEET #2

F. Anchor and support supply line with pipe straps

G. Cap end of fixture supply line

H. Check with instructor for evaluation of job

I. Clean up area and return all tools and equipment

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JOB SHEET #3--ROUGH-IN WATER SUPPLY LINES FOR WATER HEATERS

EVALUATION: Given a previously installed cold water line above or below the floor level, fixture manufacturer's rough-in specifications, and access to plumbing tools, equipment and supplies, rough-in a 3/4" diameter copper water supply line for a hot water heater. The stubbed-out supply line must be located with ± 1/2" of the manufacturer's specifications. Joints must not leak.

I. Tools and equipment

   A. 6' rule or steel tape

   B. Soldering equipment

   C. Tubing

   D. Fittings and valves

   E. Pipe straps and nails

   F. Hammer

II. Procedure

   A. Mark location of water supply line on wall

   B. Cut in and solder tee on main supply line, if necessary

   C. Connect fixture supply branch to main supply tee

   D. Install supply line out of wall at correct height

   (NOTE: Normally, tubing must protrude 6" out of wall.)

   E. Anchor and support supply line as necessary

   F. Cap end of fixture supply line

   G. Check with instructor for evaluation of job

   H. Clean up area and return all tools and equipment

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JOB SHEET #4--MAKE WATER PRESSURE TESTS ON WATER SUPPLY SYSTEMS

EVALUATION: Furnished the necessary tools, equipment, materials, and a hydrostatic pump, test the water supply lines in a building for leaks. Evaluation will include correct use of procedures and accuracy of results.

I. Tools and equipment

  A. Testing apparatus

  B. Pipe caps and plugs

  C. Pipe wrenches

  D. Pipe compound or tape

II. Procedure

  A. Cap or plug all open water supply points in building

  B. Assemble testing apparatus

  C. Connect testing apparatus at temporary water service valve

  D. Remove cap or plug from uppermost supply point; bleed air and recap

  E. Purge air from system, using bleed method

  F. Apply desired pressure to system, using pump

  G. Close gate valve nearest pump; observe gauge for pressure drop

  (NOTE: If drop occurs, check system for leaks.)

  H. If no drop in pressure has occurred, note pressure reading and close second gate valve

  I. Recheck in one hour by opening second gate valve and observing pressure drop

  J. Close both gate valves

  K. Remove pump, allow system to remain pressurized 24 hours and recheck

  L. Check with instructor for evaluation of job

  M. Clean up the area and return all tools and equipment

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WATER SYSTEMS
UNIT III

NAME ______________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Any link between contaminated water and potable water in the water system

_____b. Water which is satisfactory for drinking and domestic purposes

_____c. The depth of frost penetration in the soil

_____d. Amount of force or pressure created by the depth of one foot of water

_____e. A faucet on the outside of the building to which a garden hose can be attached

_____f. A full opening valve installed in the water line wherever a cut-off is required

_____g. Flow pressure loss caused by liquid coming in contact with the inside of the pipe

1. Pressure head
2. Shut-off valve
3. Potable water
4. Sill cock
5. Frost line
6. Cross connection
7. Friction loss

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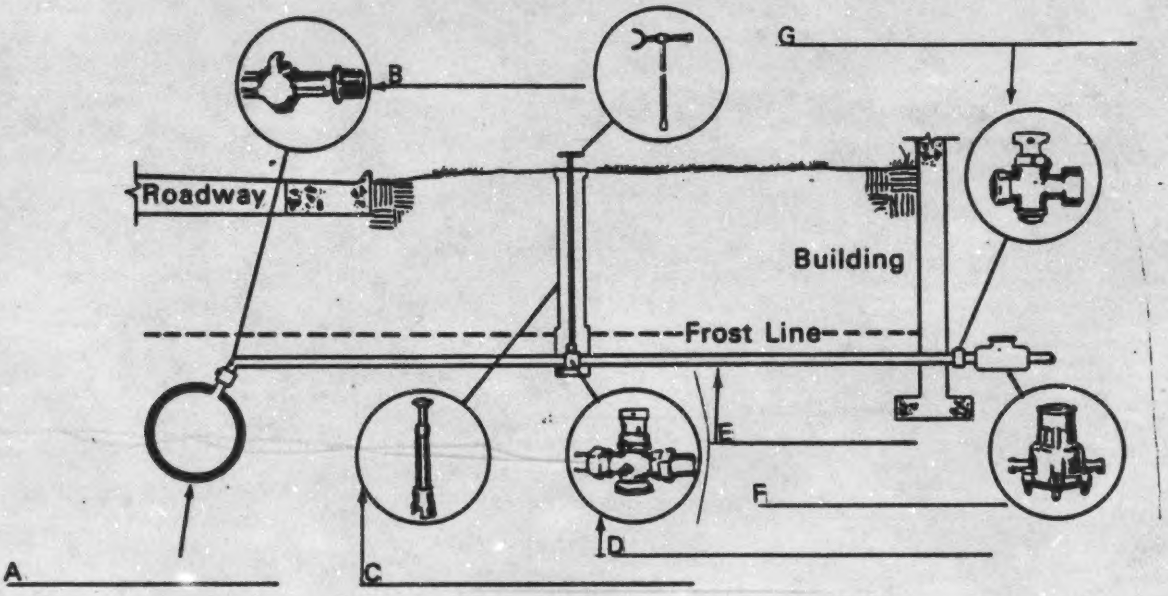
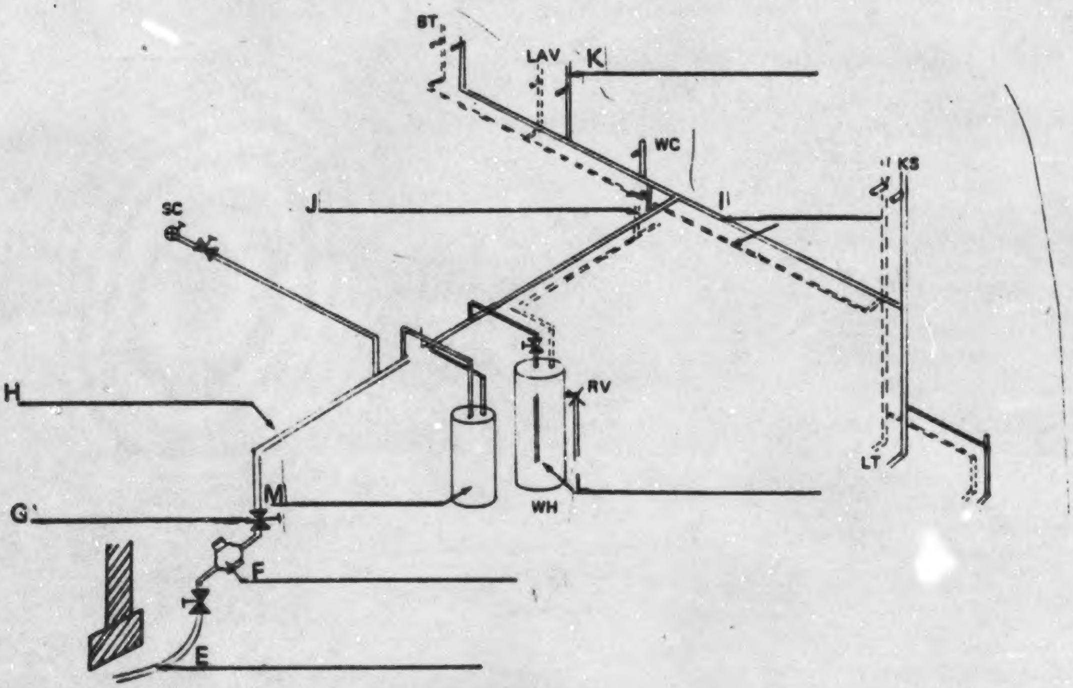
2. Identify the following components of a water system in a single-family dwelling.


G
B
Roadway
Building
Frost Line
E
F
D
A
C


BT
LAV
K
WC
KS
J
I
SC
RV
H
WH
LT
M
G
F
E

3. Match the components of a water system in a single-family dwelling on the right to the correct functions.

_____a. A large pipe, buried in the street, which distributes water throughout the town or city

_____b. Water pipe which supplies water from the water main or other source of supply to the building served

_____c. Records amount of water consumed by residence or dwelling

_____d. A valve placed in the service line at or near the curb which permits easy control over the system

_____e. A cylindrical casting placed over the curb stop to allow remote opening and closing of the stop

_____f. Pipes which carry water from the service pipe to fixtures in the building

_____g. A valve installed between the street and the water meter

_____h. Pipes which rise vertically from a horizontal pipe

_____i. A valve installed in the water line wherever a cut-off is required

_____j. A closed section of pipe or coil, or a patented device designed to absorb shock caused by a rapidly closing valve or faucet; this prevents water-hammer and is installed at time of roughing in

_____k. A valve installed in the service pipe at the water main

1. Shut-off valve
2. Distribution pipes
3. Water meter
4. Water main
5. Curb stop
6. Meter stop
7. Air chamber
8. Corporation stop
9. Riser pipes
10. Curb box
11. Service pipe

4. Select factors to consider when installing a hot water system by placing an "X" in the appropriate blanks.

_____a. Inlet pipe to the water heater must be at least as large as the outlet pipe

_____b. Hot water distribution pipes are equal in sizing and design to the cold water distribution pipe

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______ c. Water heater is located according to source of cold water supply

______ d. Water heater is located according to source of fuel supply

______ e. Main hot water pipe should be larger in size than the main cold water pipe

5. Select the true statements about sizing of pipes in residential water systems by placing an "X" to the left of the statements which are true.

______ a. Water pressure increases as the height of the water decreases

______ b. Distribution pipes vary in size according to their fixture application

______ c. Number and type of fittings affect water pressure

______ d. Water pressure is increased by friction loss caused by the water coming in contact with the inside of the pipe

______ e. Most town or city water supplies are disbursed from elevated tanks which distribute the water by gravity

______ f. A 1" column of water will create .433 lbs. per sq. inch of pressure at the base of the column

6. Distinguish between materials used for pipes and materials used for valves in water pipe systems by placing a "P" to the left of the materials used for pipes and a "V" to the left of those used for valves.

(NOTE: Some materials may be used for both pipes and valves.)

______ a. Brass

______ b. Plastic

______ c. Copper

______ d. Galvanized iron

7. Select the true statements about the prevention of frozen pipes in cold weather by placing an "X" to the left of the statements which are true.

______ a. Avoid installing pipes in outside walls

______ b. Outside building pipe lines must be buried above frost line

______ c. Avoid installing pipes in inside walls

______ d. Insulate pipes in crawl spaces

______ e. Install freeze-proof type hose bibs

_____ f. If pipe is installed in an area subject to freezing, avoid installing a drain valve

_____ g. If in doubt, insulate or relocate pipes

_____ h. Outside building pipe lines must be buried below frost line

8. List two methods of preventing contamination of water systems by cross connections.

   a.

   b.

9. Describe two methods of testing a water system for leaks.

   a. Water method

   b. Air method

10. Make an isometric drawing of a hot and cold water system for a two-story house.

11. Determine pipe sizes for a hot and cold water system for a two-story house.

12. Demonstrate the ability to:

    a. Rough-in water supply lines for bathtubs.

    b. Rough-in water supply lines for water closets.

    c. Rough-in water supply lines for water heaters.

    d. Make water pressure tests on water supply systems.

    (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

WATER SYSTEMS
UNIT II

ANSWERS TO TEST

1. a. 6
   b. 3
   c. 5
   d. 1
   e. 4
   f. 2
   g. 7

2. a. Water main (city main)
   b. Corporation coupling and valve
   c. Curb box
   d. Curb stop valve
   e. Service pipe
   f. Water meter
   g. Water meter stop valve
   h. Main water line
   i. Distribution pipes
   j. Riser pipes
   k. Air chambers
   l. Water heater
   m. Water conditioner

3. a. 4
   b. 11
   c. 3
   d. 5
   e. 10
   f. 2
   g. 6
   h. 9
   i. 1
   j. 7
   k. 8

4. a, b, c, d

5. b, c, e, f

6. a. v
   b. p, v
   c. p
   d. p, v

7. a, d, e, g, h

8. a. Fixtures and fittings must be installed to provide an air-gap

   b. Vacuum breakers must be provided where necessary

9. Description should include:

   a. Water method

      1) The test pressure should not be less than the pressure of the system to be used

      2) Codes usually specify that water for these tests come from normal source of supply

      3) Testing from the normal source of supply requires that the plumbing installation be connected to the street main or to a neighboring residence

   b. Air method

      1) Test pressure is usually 50 p.s.i. for 4 hours

      2) Pressure gauge must be supplied and attached to piping installation by plumber

10. Evaluated to the satisfaction of the instructor.

11. Evaluated to the satisfaction of the instructor.

12. Performance skills evaluated to the satisfaction of the instructor.

JOINING PIPES
UNIT III

UNIT OBJECTIVES

After completion of this unit, the student should be able to select tools, materials, and equipment necessary to join pipe. The student should also demonstrate the ability to join wrought iron, cast iron, copper, and plastic pipe. This knowledge will be evidenced by correctly performing the procedures outlined on the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with joining pipe to the correct definitions or descriptions.
2. Select tools, materials, and equipment necessary to join steel pipe.
3. Select tools, materials, and equipment necessary to join cast iron pipe by the caulking, compression, and no-hub methods.
4. Select tools, materials, and equipment necessary to join copper tubing by the sweat joint, compression, and flare methods.
5. Select tools, materials, and equipment necessary to join P.V.C. and flexible plastic pipe.
6. Demonstrate the ability to:
    a. Cut, ream, thread and join a piece of 1" galvanized steel pipe to a 1" galvanized steel fitting.
    b. Measure, cut, and join cast iron pipe to a cast iron fitting using the caulking method.
    c. Join cast iron pipe to a cast iron fitting using a no-hub joint.
    d. Join cast iron pipe to a cast iron fitting using a compression joint.
    e. Cut, ream, and join copper tubing using the sweat method.
    f. Cut, ream, and join copper tubing using a compression joint.
    g. Cut, ream, and join copper tubing using a flare joint.
    h. Cut, ream, and join copper tubing using a hammered flare joint.

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i. Cut, ream, and join P.V.C. pipe to a P.V.C. fitting.

j. Cut, ream, and join flexible plastic pipe with insert fittings.

k. Join clay pipe with couplings.

l. Wipe clay pipe joints.

m. Cut cast iron soil pipe with snap-type chain cutter.

n. Bend copper tubing with a spring bender.

o. Thread steel pipe with adjustable die.

p. Join cast iron pipe to clay pipe.

JOINING PIPES
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:
   - A. Provide student with objective sheet.
   - B. Provide student with information and job sheets.
   - C. Make transparencies.
   - D. Discuss unit and specific objectives.
   - E. Discuss information sheets.
   - F. Demonstrate and discuss the procedures outlined in the job sheets.
   - G. Review the proper use and care of the air acetylene torch.
   - H. Give test

II. Student:
   - A. Read objective sheet.
   - B. Study information sheet.
   - C. Complete job sheets.
   - D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:
   - A. Objective sheet
   - B. Information sheet
   - C. Transparency masters
     1. TM 1--Tools for Cutting and Threading Iron Pipe
     2. TM 2--Tools to Join Cast Iron Pipe by the Caulking Method
     3. TM 3--Tools to Join Cast Iron Pipe by the Compression Method
     4. TM 4--Tools to Join Cast Iron Pipe by the No-Hub Method

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5. TM 5--Tools to Join Copper Tubing by the Sweat Joint Method
6. TM 6--Tools to Join Copper Tubing by the Compression Method
7. TM 7--Tools to Join Copper Tubing by the Flare Method
8. TM 8--Tools for Making P.V.C. Joints

D. Job sheets

1. Job Sheet #1--Cut, Ream, Thread, and Join a Piece of One Inch Galvanized Steel Pipe to a One Inch Fitting
2. Job Sheet #2--Measure, Cut, and Join Cast Iron Pipe to a Cast Iron Fitting Using the Caulking Method
3. Job Sheet #3--Join Cast Iron Pipe to a Cast Iron Fitting Using a No-hub Joint
4. Job Sheet #4--Join Cast Iron Pipe to a Cast Iron Fitting Using a Compression Joint
5. Job Sheet #5--Cut, Ream, and Join Copper Tubing Using the Sweat Method
6. Job Sheet #6--Cut, Ream, and Join Copper Tubing Using a Compression Joint
7. Job Sheet #7--Cut, Ream, and Join Copper Tubing Using a Flare Joint
8. Job Sheet #8--Cut, Ream, and Join Copper Tubing Using a Hammered Flare Joint
9. Job Sheet #9--Cut, Ream, and Join P.V.C. Pipe to a P.V.C. Fitting
10. Job Sheet #10--Cut, Ream, and Join Flexible Plastic Pipe With Insert Fittings
11. Job Sheet #11--Join Clay Pipe with Couplings
12. Job Sheet #12--Wipe Clay Pipe Joints
13. Job Sheet #13--Cut Cast Iron Soil Pipe with Snap-type Chain Cutter
14. Job Sheet #14--Bend Copper Tubing With a Spring Bender
15. Job Sheet #15--Thread Steel Pipe With Adjustable Die
16. Job Sheet #16--Join Cast Iron Pipe to Clay Pipe

E. Test

F. Answers to test

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II. Unit References:

A. Blankenbaker, Keith E. *Modern Plumbing.* South Holland, Ill: Goodheart-Willcox, 1978.

B. Slater, Harry. *Plumbing 1 and 2.* Albany, New York: Delmar Publishing, 1958.

C. Bureau of Naval Personnel. *Tools and Their Uses,* Rate Training Manual. Washington, D.C.: U.S. Gov't Printing Office, 1971.

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JOINING PIPES
UNIT III

INFORMATION SHEET

I. Terms and definitions or descriptions

   A. Caulking--Method of joining cast iron pipe fittings using lead and oakum

   B. Sweating--Method of joining copper tubing using flux and solder applied with heat

   C. Threading--Cutting spiral grooves on the end of pipe to facilitate joining with a fitting or another pipe

   D. Cementing--Method of using a solvent to join P.V.C. pipe

   E. Insert joining--Method of joining flexible plastic pipe

   F. Reaming--Removing burrs from inside edge of pipe

   G. No-hub--Type of cast iron pipe to be joined by special fittings

   H. Neoprene gasket-Insert in cast iron hub which makes up part of a water tight compression joint

   I. Hub--Expanded end of cast iron pipe which receives the end of pipe or fitting

   (NOTE: The "hub" is sometimes referred to as the "bell".)

   J. Spigot end--End of fitting or pipe which is inserted into hub (or bell)

   K. Pipe compound (dope)--Substance applied to pipe threads to help seal the joint

   L. Teflon tape--Tape used as a joint sealant in place of pipe compound

II. Tools, materials and equipment necessary to join wrought iron pipe (Transparency 1)

   A. Cutter

   B. Reamer

   C. Pipe vise

   D. Oil can

   E. Adjustable stock-and-die set

   F. Pipe compound or tape

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INFORMATION SHEET

G. Pipe wrench

H. Pipe

I. Fitting

III. Tools, materials, and equipment necessary to join cast iron pipe

A. Caulking method (Transparency 2)

1. Soil pipe cutter
2. Caulking irons
3. Yarning irons
4. Cut-off chisel
5. Lead pot
6. Furnace
7. Ladle
8. Hammer
9. Asbestos joint runner
10. Lead
11. Oakum
12. Pipe
13. Fitting
14. Safety glasses

B. Compression method (Transparency 3)

1. Neoprene gasket
2. Gasket lubricant
3. Lead hammer
4. Pipe puller
5. Pipe
6. Fitting

INFORMATION SHEET

C. No-hub method (Transparency 4)
    1. Neoprene gasket
    2. Stainless steel shield-and-clamp assembly
    3. Approved torque wrench
    4. Pipe
    5. Fitting

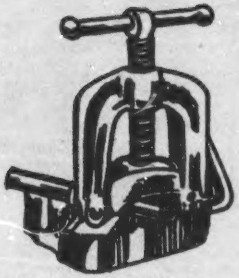
IV. Tools, materials, and equipment necessary to join copper tubing
  A. Sweat joint method (Transparency 5)
    1. Tubing cutter
    2. Reamer
    3. Sand cloth, emery cloth, steel wool
    4. Flux with brush
    5. Wire solder
    6. Torch
    7. Type B gas tank with wrench
    8. Striker
    9. Wiping cloth
    10. Tubing
    11. Fitting
    12. Fire extinguisher
  B. Compression method (Transparency 6)
    1. Tubing cutter
    2. Reamer
    3. Fitting
    4. Open-end wrench or flare-nut wrench
    5. Adjustable open end wrench
    6. Tubing

- C. Flare method (Transparency 7)
    1. Tubing cutter
    2. Reamer
    3. Flaring tool and block
    4. Open-end wrench or flare-nut wrench
    5. Adjustable wrench
    6. Tubing
    7. Fitting
    8. Hammer type flaring tool
    9. Swaging tool

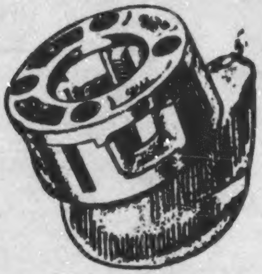
V. Tools, materials, and equipment necessary to join P.V.C. and flexible plastic pipe (Transparency 8)

- A. P.V.C. pipe
    1. P.V.C. pipe cutter or handsaw
    2. Reamer or knife
    3. Cleaning solvent with brush
    4. Solvent cement with brush
    5. Pipe
    6. Fitting
    7. Wiping cloth
- B. Flexible plastic pipe
    1. Pipe cutter or handsaw
    2. Reamer or knife
    3. Pipe
    4. Fitting
    5. Clamp
    6. Screwdriver
    7. Socket wrench

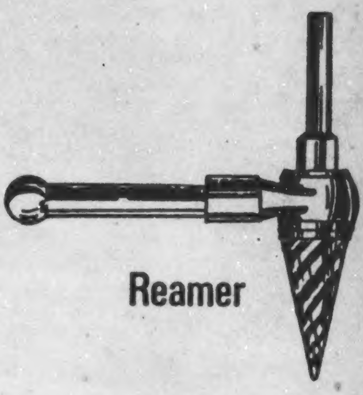
Tools For Cutting and Threading Iron Pipe



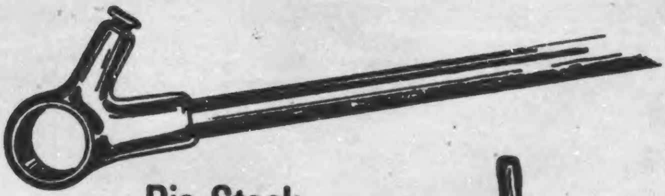
Pipe Vise



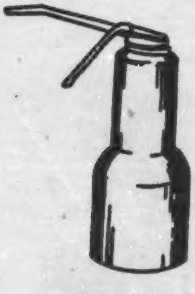
Die Head



Reamer

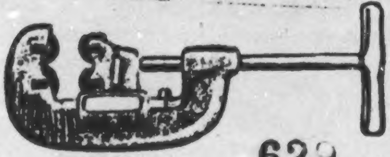


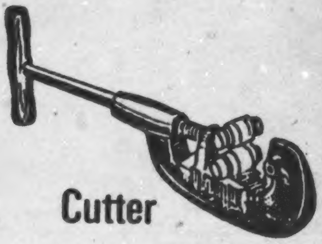
Die Stock



Oil Can

4-Wheel Pipe Cutter

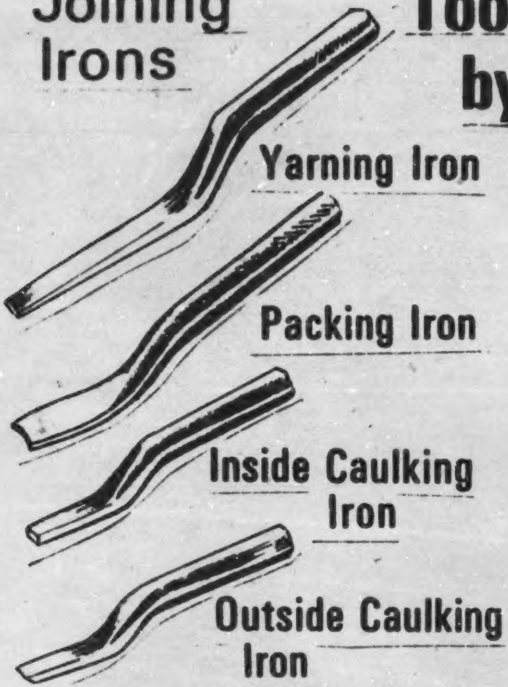


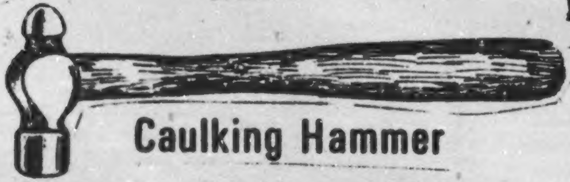


Cutter

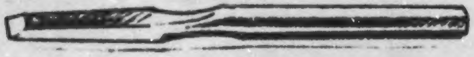
Tools to join Cast Iron Pipe by the Caulking Method

Joining Irons

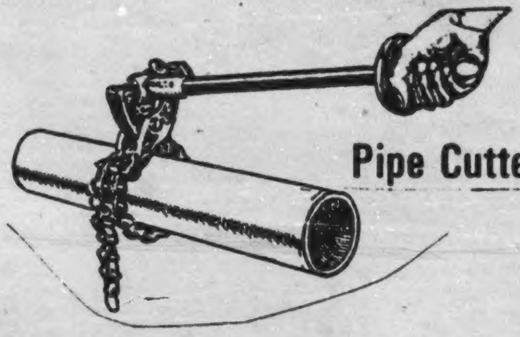

Yarning Iron
Packing Iron
Inside Caulking Iron
Outside Caulking Iron



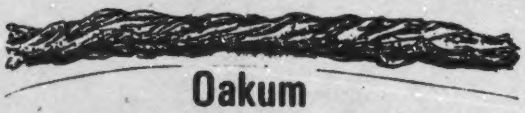
Caulking Hammer



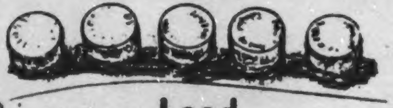
Cut-Off Chisel



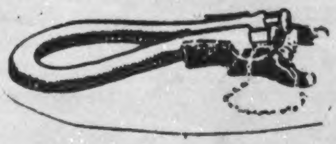
Pipe Cutter



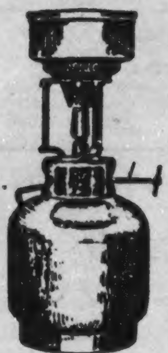
Oakum



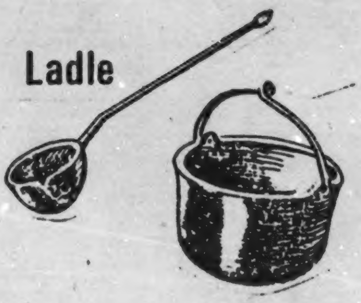
Lead

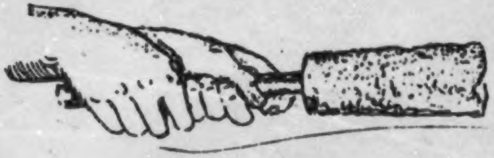


Asbestos Joint Runner



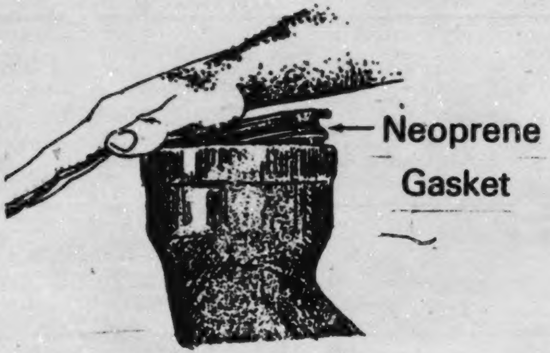
Furnace

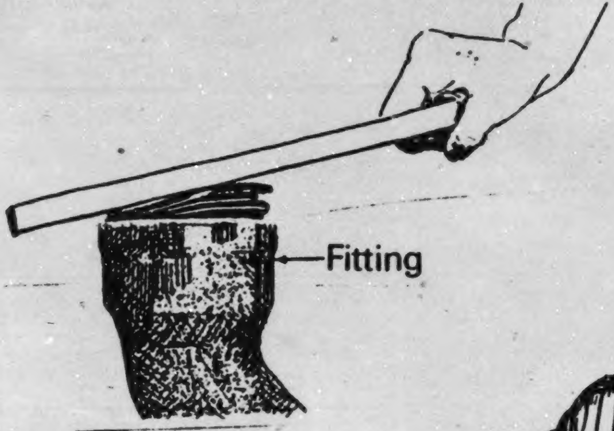

Ladle
Lead Pot

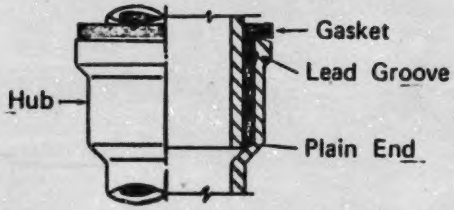


Lead Hammer

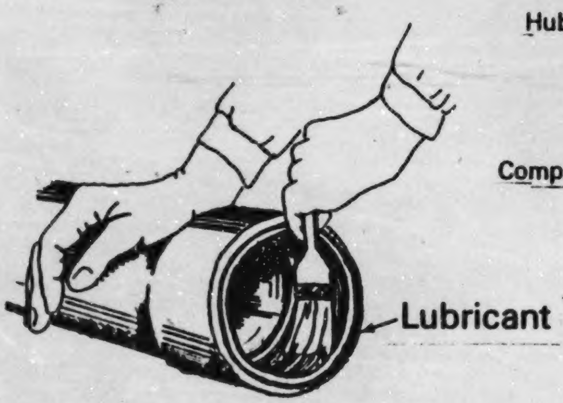
Tools to Join Cast Iron Pipe by the Compression Method

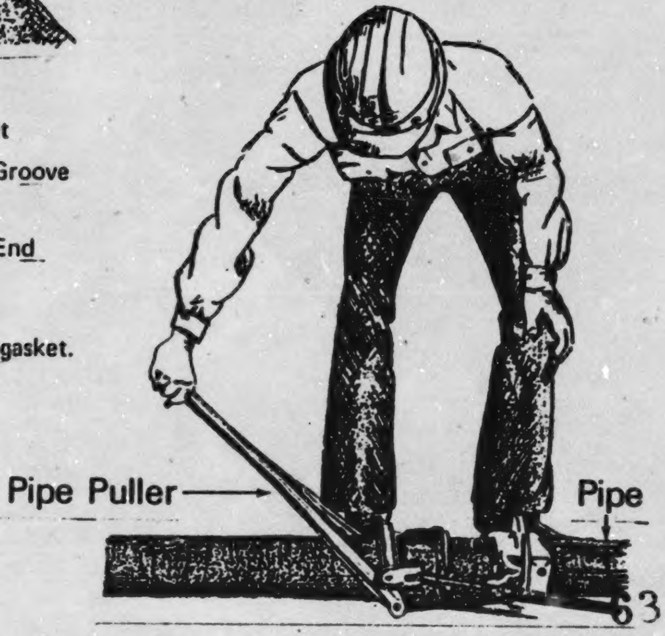

Neoprene
Gasket



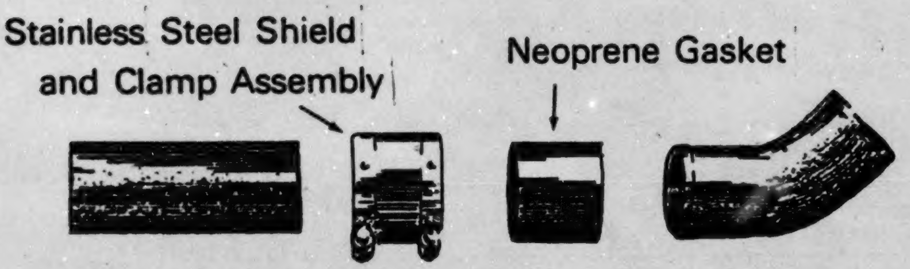

Gasket
Lead Groove
Hub
Plain End

Compression soil pipe joint with gasket.

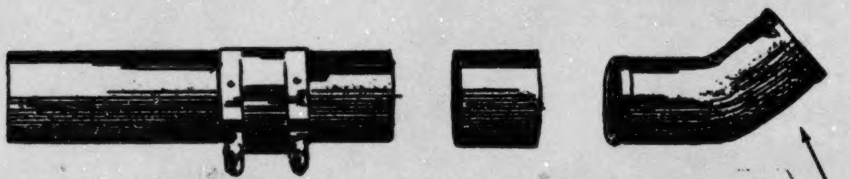



Pipe Puller
Pipe

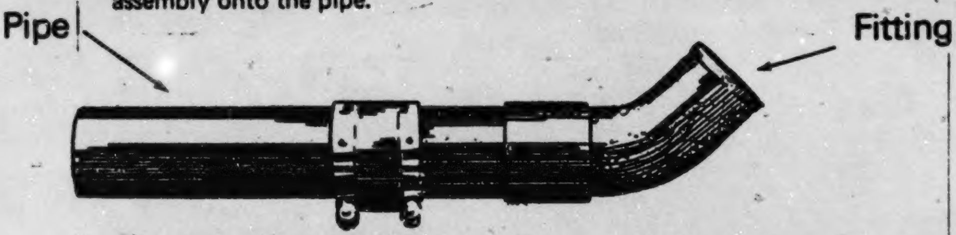
Tools to Join Cast Iron Pipe by the No-Hub Method


Stainless Steel Shield
and Clamp Assembly
Neoprene Gasket

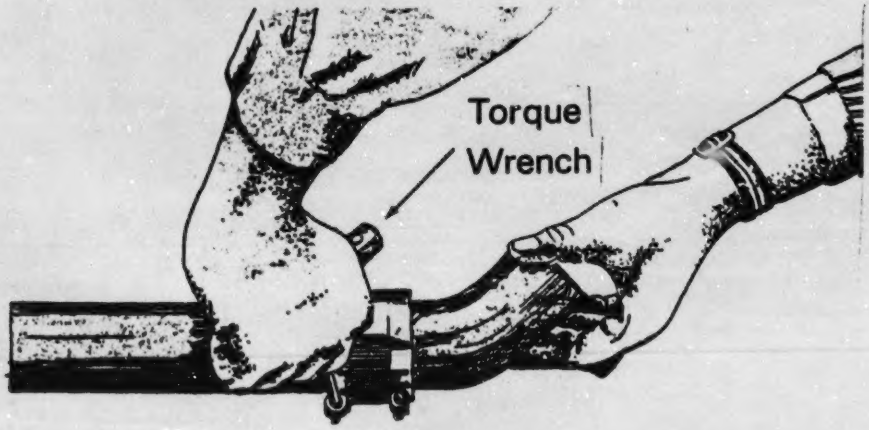
Assembly of a no-hub soil pipe joint: Detach the neoprene sleeve from the stainless steel clamp assembly.



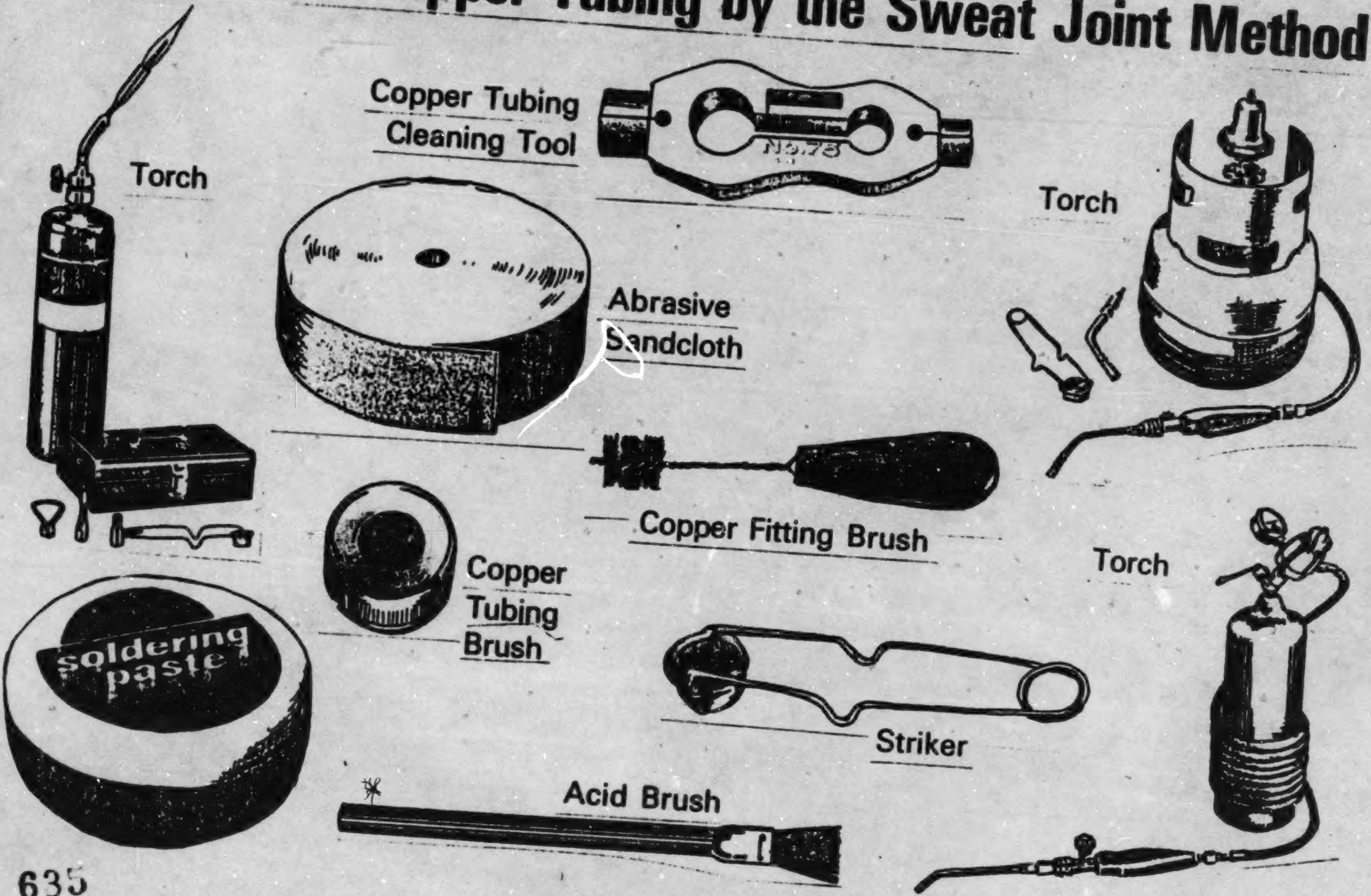
Assembly of a no-hub soil pipe joint: Slide the stainless steel clamp assembly onto the pipe.


Pipe
Fitting

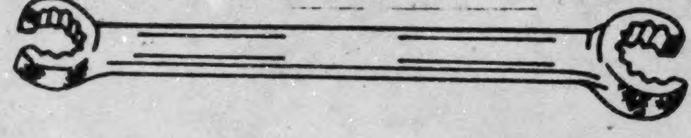
Assembly of a no-hub soil pipe joint: Insert the spigot ends of the fitting into the neoprene gasket until they butt against the separator ring.

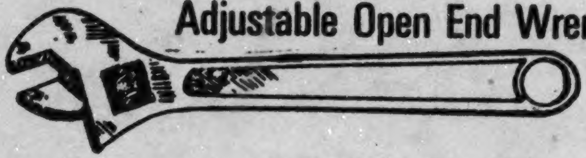

Torque
Wrench

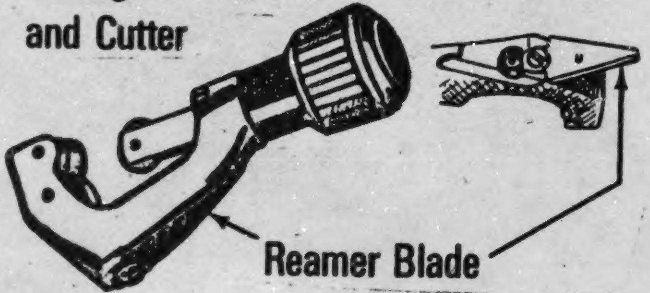
Tools to Join Copper Tubing by the Sweat Joint Method

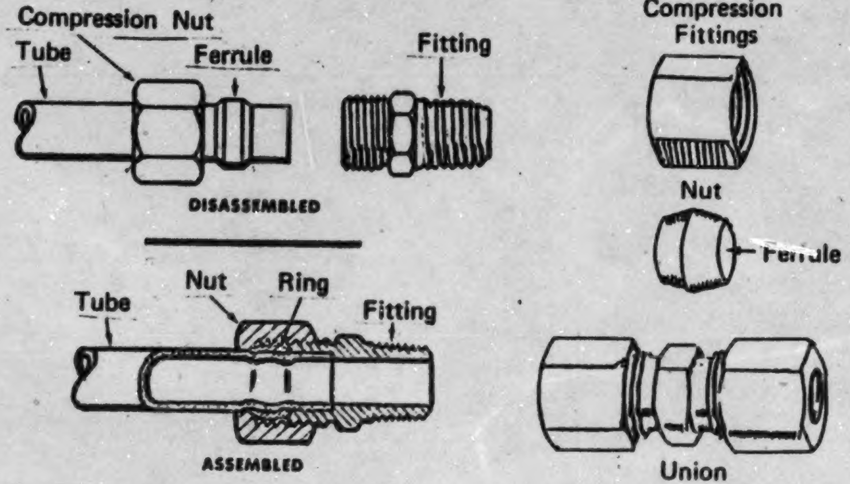

Torch
Copper Tubing Cleaning Tool
No.75
Torch
Abrasive Sandcloth
Copper Fitting Brush
Copper Tubing Brush
Torch
soldering paste
Striker
Acid Brush

Tools to Join Copper Tubing by Compression Method


Flare Nut Wrench

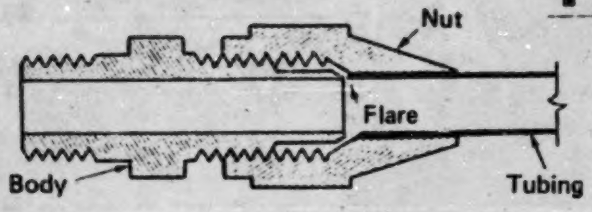

Adjustable Open End Wrench


Tubing Reamer and Cutter
Reamer Blade

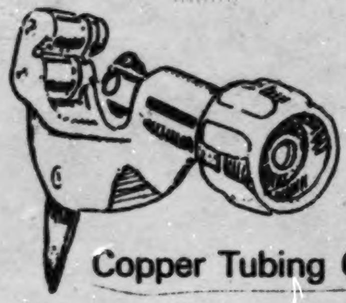

Compression Nut
Tube
Ferrule
Fitting
DISASSEMBLED
Tube
Nut
Ring
Fitting
ASSEMBLED
Compression Fittings
Nut
Ferrule
Union

Fittings

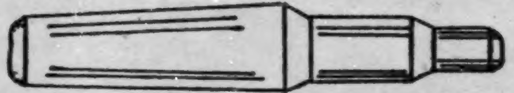
Tools to Join Copper Tubing by the Flare Method



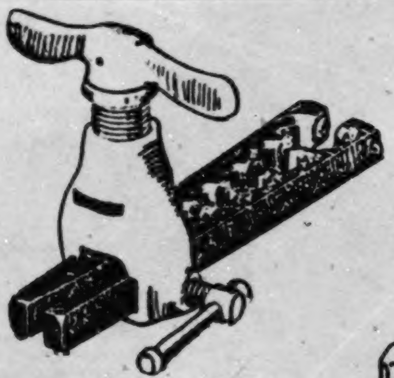
Flare Connection



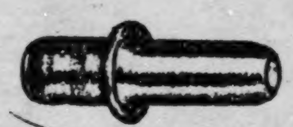
Copper Tubing Cutter



Swaging Tool

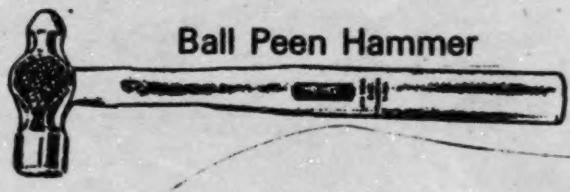


Yoke and Screw Flaring Tool

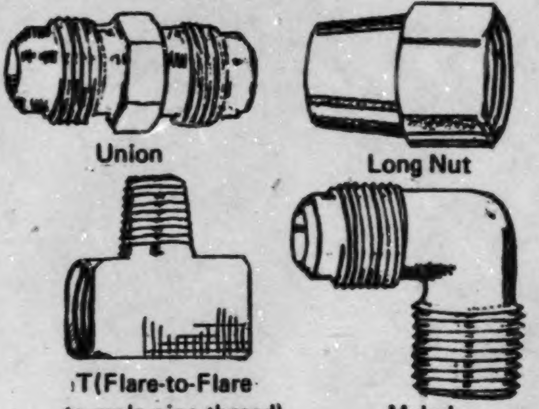


Hammer Type Flaring Tool

Ball Peen Hammer



Flared Fittings



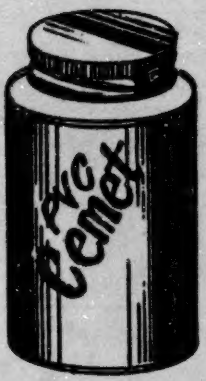
Union

Long Nut

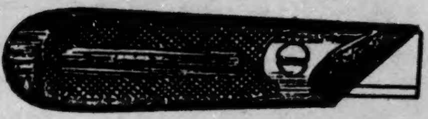
T(Flare-to-Flare to male pipe thread).

Male L

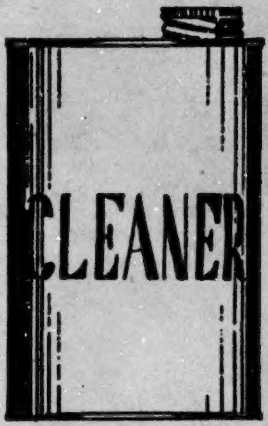
Tools For Making P.V.C. Joints



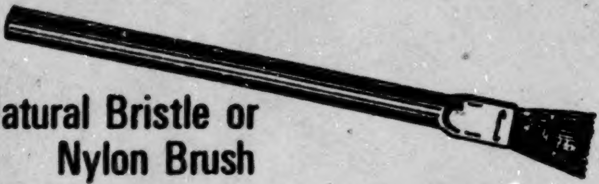
P.V.C. Cement



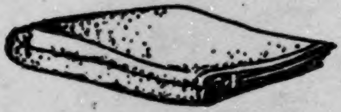
Knife



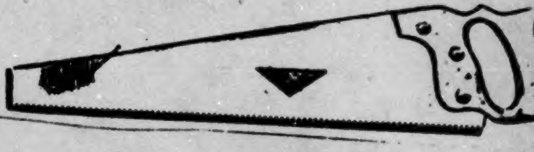
P.V.C. Cleaner



Natural Bristle or
Nylon Brush



Clean Towels



Handsaw

JOINING PIPES
UNIT III

JOB SHEET #1--CUT, REAM, THREAD, AND JOIN A PIECE OF ONE INCH GALVANIZED STEEL PIPE TO A ONE INCH FITTING

EVALUATION: Given access to tools, equipment and materials, cut, ream, thread and join a piece of one inch galvanized steel pipe to a one inch fitting. The instructor will evaluate the use of correct methods, neatness, and general appearance.

I. Tools and materials

   A. Die

   B. Die stock

   C. Pipe vise

   D. Flat file

   E. Oil can (cutting oil)

   F. Steel pipe

      (NOTE: Ask the instructor what type and size of steel pipe to use for this job.)

   G. Pencil

   H. Shop towel

   I. Safety glasses

   J. Pipe cutter

   K. Reamer

II. Procedure

   A. Put on safety glasses and gather tools and equipment

   B. Secure pipe in vise

   C. Mark place for cut with pencil

   D. Open pipe cutter until it will fit over pipe

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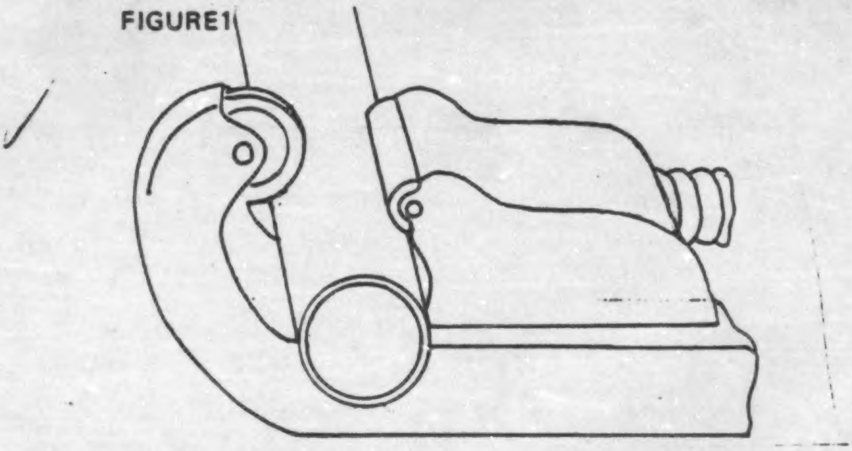
JOB SHEET #1

E. Locate cutter wheel on the pencil mark (Figure 1)

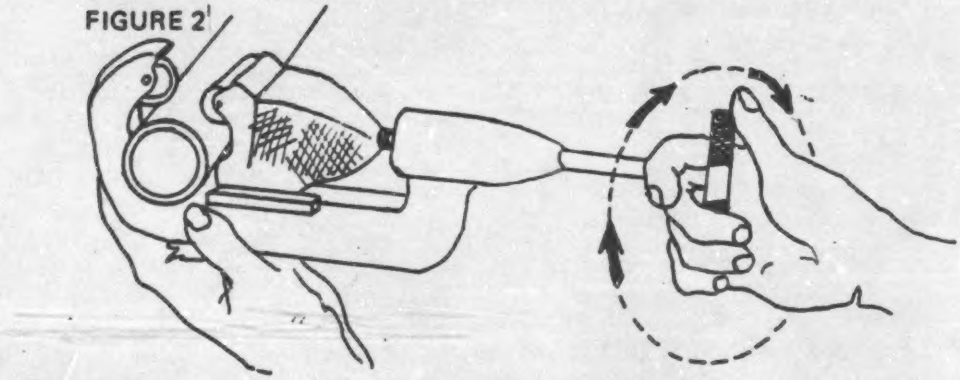
FIGURE 1



F. Snug cutter up to pipe by rotating screw handle (Figure 2)

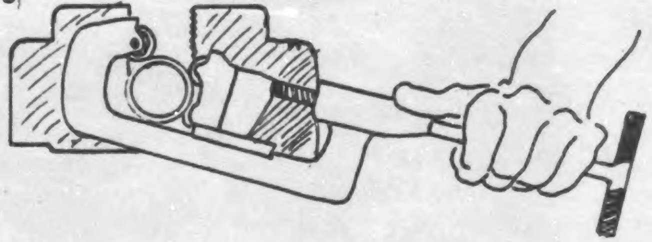
(NOTE: Don't overtighten as this can break cutter wheel.)

FIGURE 2



G. Rotate cutter counterclockwise to start groove (Figure 3)

FIGURE 3



H. Tighten cutter hand 1/4 of a turn for each full revolution around the pipe

(NOTE: Overtightening can cause cutters to break.)

JOB SHEET #1

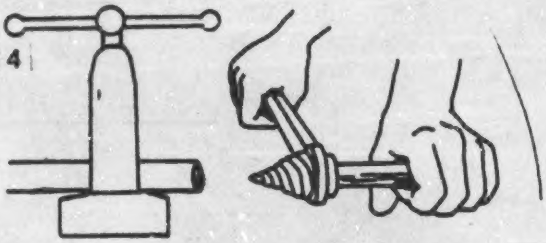
I. Continue process until pipe is cut

(CAUTION: When cutting short pieces of pipe be careful not to cut your arm while rotating the cutter around the pipe.)

J. Clean pipe and cutter with shop towel

K. Insert reamer tip in pipe (Figure 4)

FIGURE 4

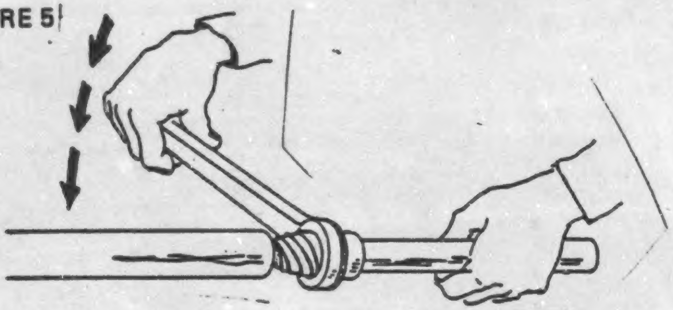


L. Apply light forward pressure to push reamer into pipe

M. Start rotating reamer (Figure 5)

(NOTE: Reamer should bite instantly if proper pressure is applied. Reamer can be damaged if rotated in the wrong direction.)

FIGURE 5



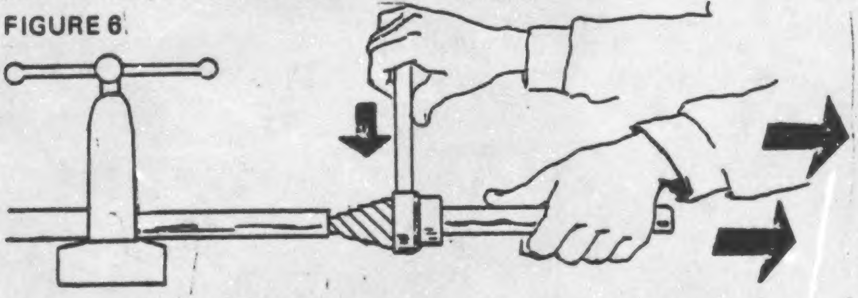
N. Rotate reamer until burrs are removed (Figure 5)

(NOTE: This is a developed skill; the reamer can be pulled out and your progress inspected.)

O. Pull reamer back while continuing to rotate (Figure 6)

(NOTE: This prevents the reamer from leaving a burr.)

FIGURE 6



P. Clean reamer with shop towel

Q. Lubricate end of pipe with cutting oil

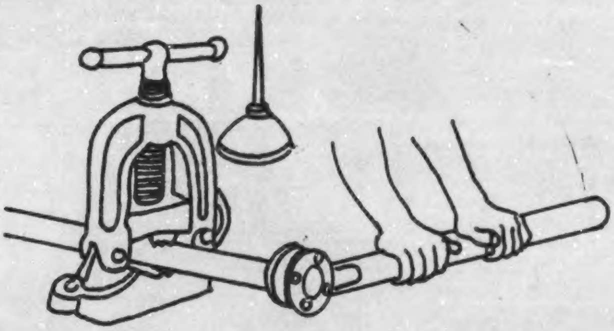
R. Place die in die stock and secure

S. Place die on pipe

T. Start die straight on the pipe

U. Press die on pipe evenly and turn the die (Figure 7)

FIGURE 7



V. Apply plenty of cutting oil while turning the die

(NOTE: Place a container under pipe vise to catch dripping oil.)

W. Continue this procedure until the desired amount of threads have been cut

X. Release die by turning ratchet lock 180°

Y. Remove die by turning counterclockwise

(NOTE: Hold onto the die stock firmly while removing it so as not to drop it when it comes to the end of the threads.)

Z. Clean threads with a brush

(CAUTION: Do not use compressed air for cleaning.)

AA. Have instructor inspect work

BB. Clean up tools and put them away, and clean the area

JOINING PIPES
UNIT III

JOB SHEET #2--MEASURE, CUT, AND JOIN CAST IRON PIPE TO A CAST IRON FITTING USING THE CAULKING METHOD

EVALUATION: Given access to tools, equipment and materials, measure, cut, and join cast iron pipe to a cast iron fitting using the caulking method. The instructor will evaluate the use of correct methods & tools, general appearance, and neatness.

I. Tools and materials

   A. 6' rule

   B. Pipe cutter

   C. Yarning irons

   D. Caulking irons

   E. Lead pot

   F. Furnace

   G. Ladle

   H. Hammer

   I. Joint runner

   J. Lead

   K. Oakum

   L. Pipe

   M. Fitting

   N. Safety glasses (face shield works well for this operation)

II. Procedure

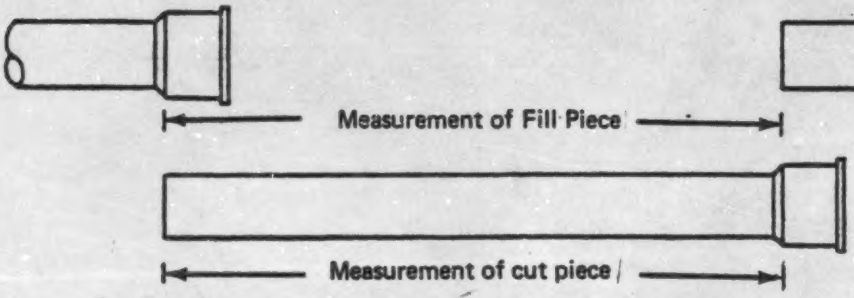
   A. Vertical position

      1. Measure and mark pipe (Figure 1)

JOB SHEET #2

(NOTE: Cast iron pipe with hubs are measured from the shoulder of the hub.)

FIGURE 1


Measurement of Fill Piece
Measurement of cut piece

2. Cut pipe

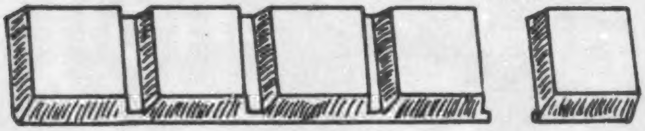
   (NOTE: Keep cutters lined up straight around the circumference of the pipe.)

3. Wipe hub and spigot ends of pipe and fitting dry of any foriegn matter

   (CAUTION: Moisture in a caulking operation can cause a serious explosion.)

4. Cut lead pigs into manageable sizes (Figure 2)

   FIGURE 2



5. Place lead pot on furnace and fill with lead

6. Light furnace and adjust flame (Figure 3)

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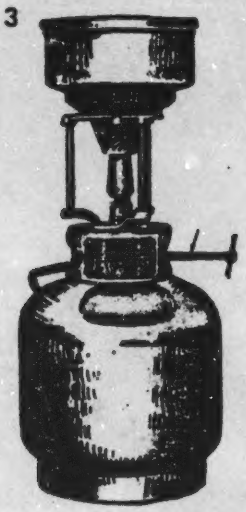
JOB SHEET #2

(CAUTION: Furnace should be placed in a safe place.)

FIGURE 3

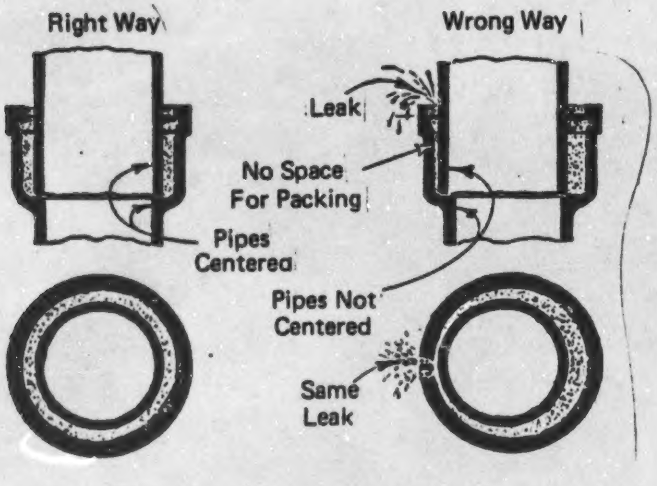


7. Cut oakum into manageable lengths, about 30"

8. Place spigot end of fittng into hub (bell) of pipe (Figure 4)

   (NOTE: Check that the spigot is centered in hub.)

FIGURE 4

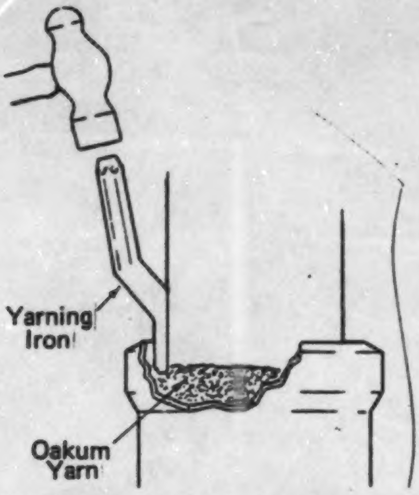

Right Way
Wrong Way
Leak
No Space For Packing
Pipes Centered
Pipes Not Centered
Same Leak

9. Yarn in the oakum to about 1" of the top of the hub, using a yarning iron (Figure 5)

JOB SHEET #2

(NOTE: Using a packing tool, occasionally tamp the oakum down tight.)

FIGURE 5



10. Warm the ladle on top of the furnace to remove any moisture and to prevent the lead from sticking

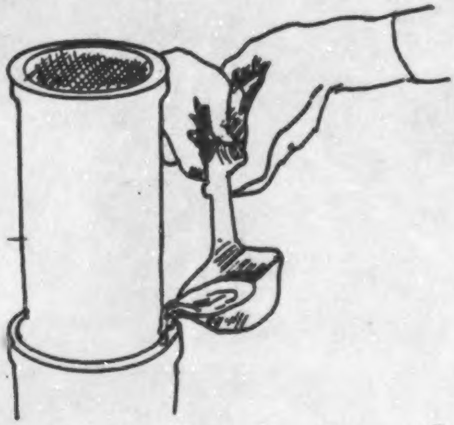
11. Carefully skim any slag from the surface of the lead pot and discard

    (CAUTION: Discard slag to a place where it will not endanger anyone.)

12. Using the ladle, dip out lead from the lead pot and fill the joint even to the hub

    (NOTE: Pour quickly to avoid cooling of the lead causing a undesirable pour.) (Figure 6)

FIGURE 6

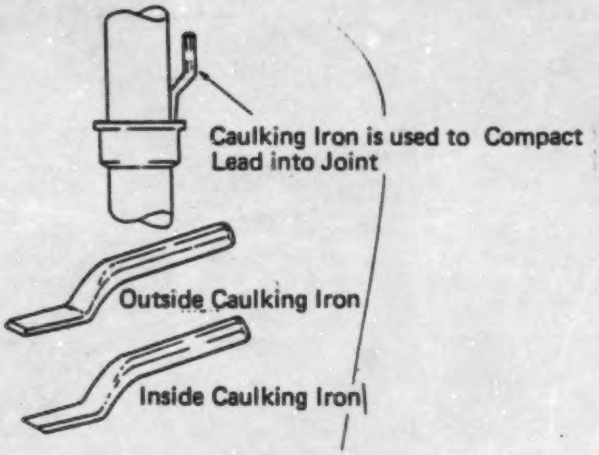


13. Shut the furnace off if no more joints are to be poured

JOB SHEET #2

14. Using an outside caulking iron, move the iron slowly around the outside edge of the lead, tamping firmly with a small ball peen hammer (Figure 7)

FIGURE 7



15. Using an inside caulking iron, move the iron slowly around the inside edge of the lead, tamping firmly with a small ball peen hammer

    (NOTE: Do not strike the caulking iron too hard because the cast iron hub might crack.)

16. Clean up the area and put the tools away

    (CAUTION: Use care in handling the hot lead pot and furnace.)

B. Horizontal position

1. Prepare tools, equipment and materials for vertical position joint

2. Position pipe and fitting in horizontal, level position

   (NOTE: If caulking is to be done on ground level, a small hole must be made under joining area.)

3. Yarn in the oakum as in the vertical position joint

   (NOTE: Keep pipe and joint together. Pipe and fitting can be easily pushed apart.)

4. Check pipe and fitting for straightness

   (NOTE: A level is necessary to establish correct pitch but "eye-balling" is generally sufficient for straightness.)

JOB SHEET #2

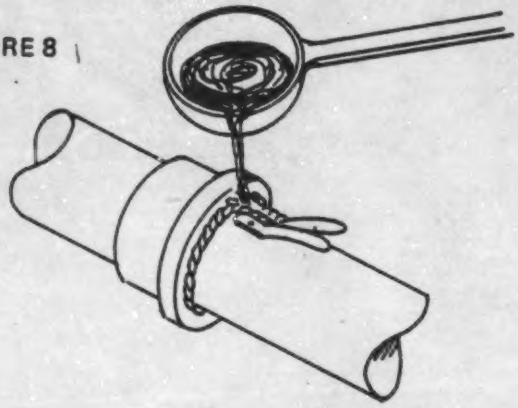
5. Wrap joint runner around spigot end of fitting and clamp tightly at top

   (NOTE: Place small amount of oakum under clamp to prevent molten lead from escaping.)

6. Pour lead into opening provided by runner and clamp (Figure 8)

   (NOTE: Pour rapidly in order to assure a good, even pour.)

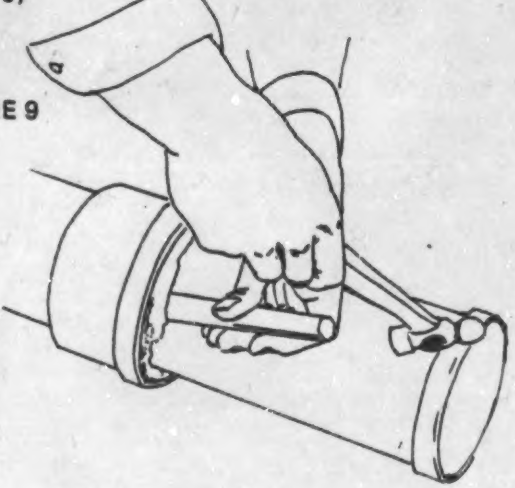
FIGURE 8



7. Return remaining lead (in ladle) to lead pot and shut off furnace

8. Caulk joint as in vertical position using inside and outside caulking irons (Figure 9)

FIGURE 9



9. Clean up area and put tools away

   (CAUTION: Use care in handling the hot lead pot and furnace.)

JOINING PIPES
UNIT III

JOB SHEET #3--JOIN CAST IRON PIPE TO A CAST IRON FITTING USING A NO-HUB JOINT

EVALUATION: Given access to tools, equipment and materials, join cast iron pipe to a cast iron fitting using a no-hub joint. The instructor will evaluate the tightness of the joint, methods and tools used, and general neatness of the job.

I. Tools and materials

- A. Neoprene gasket
- B. Stainless steel shield-and-clamp assembly
- C. Socket wrench
- D. Pipe
- E. Fitting

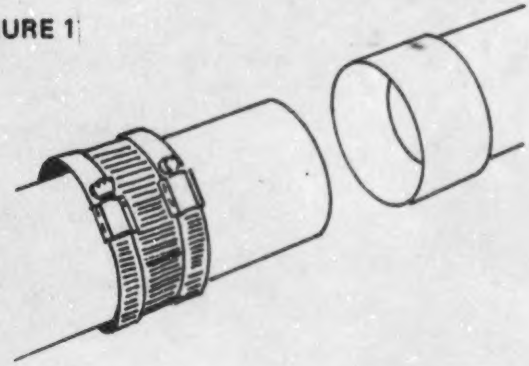
II. Procedure

A. Place neoprene gasket over one end of pipe

(NOTE: In this method of joining, no hubs are used.)

B. Place the stainless-steel shield-and-clamp assembly over the end of the other pipe (Figure 1)

FIGURE 1



C. Fit ends of the pipes against the molded shoulder inside the gasket

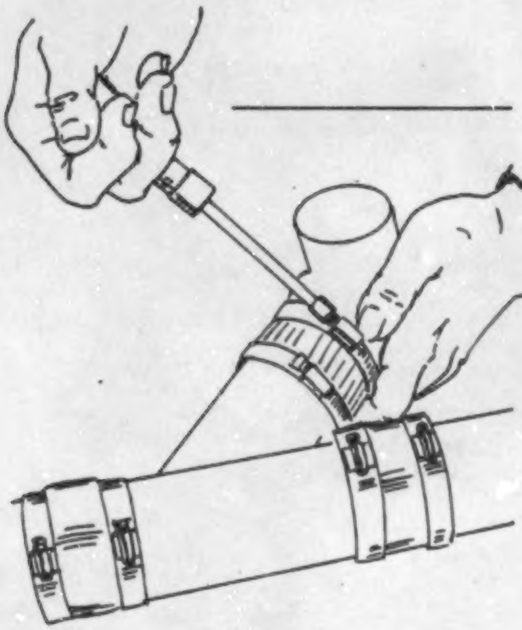
(NOTE: Pipe ends must fit snugly.)

JOB SHEET #3

D. Slide shield-and-clamp assembly over gasket and tighten clamps (Figure 2)

(NOTE: A special torque socket wrench is available for tightening clamps.)

FIGURE 2



E. Clean up area and put tools away

JOB SHEET #4--JOIN CAST IRON PIPE TO A CAST IRON FITTING USING A COMPRESSION JOINT

EVALUATION: Given access to tools, equipment and materials, join cast iron pipe to a cast iron fitting using a compression joint. Evaluation will include correct methods and tools used, neatness of the job and general appearance.

I. Tools and materials

A. Neoprene gasket

B. Gasket lubricant w/brush

C. Lead hammer

D. Pipe puller

E. Fitting

F. Pipe

G. Wiping cloth

H. Safety glasses

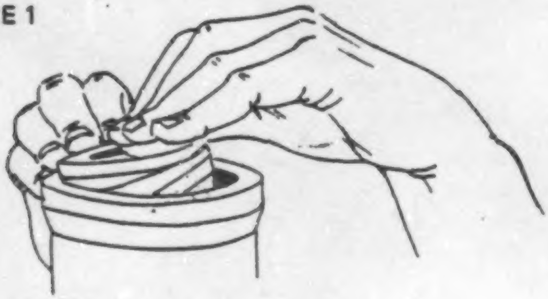
II. Procedures

A. Clean hub of pipe and spigot end of fitting

(NOTE: Spigot end of pipe and fittings for compression joining have no bead or ridge.)

B. Insert gasket into hub (Figure 1)

FIGURE 1



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JOB SHEET #4

C. Coat gasket and spigot end of fitting with lubricant

(NOTE: Always use proper lubricant in order to avoid gasket deterioration.)

D. Stand pipe in vertical position and start spigot end of fitting into gasket

(CAUTION: "Weight" of fitting and pipe must be the same; an "extra heavy" fitting will not fit into a "medium" hub.)

E. With someone holding the pipe and fitting, drive the fitting into the hub with a lead hammer (Figures 2 and 3)

(NOTE: Lead hammer can be made from a 12" piece of 3" cast iron as a mold, and a 3' piece of 1" wrought iron pipe as a handle.)

FIGURE 2

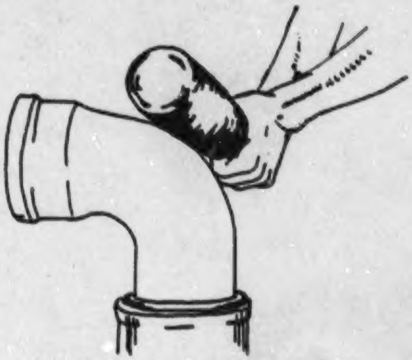
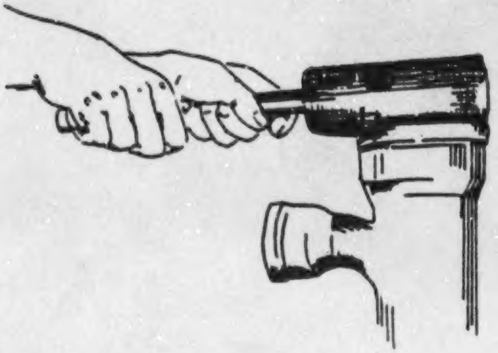


FIGURE 3



F. To join pipe to pipe or pipe to fittings, proceed through steps A, B, and C

G. With the pipes lying on the floor or ground, start the spigot end into the gasket

JOB SHEET #4

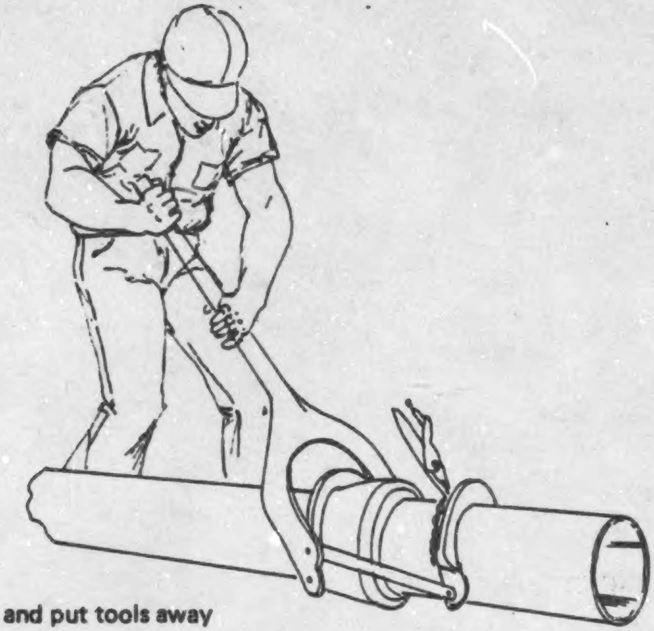
H. Clamp one end of the pipe puller to the spigot end

I. Drop the yoke end of the pipe puller behind the hub

J. Pull the handle of the puller, drawing the spigot into the hub (Figure 4)

(NOTE: This operation may have to be repeated in order to insure a tight fix.)

FIGURE 4



K. Clean up area and put tools away

JOB SHEET #5--CUT, REAM, AND JOIN COPPER TUBING USING THE SWEAT METHOD

EVALUATION: Given access to tools, equipment and materials, cut, ream and join copper tubing using the sweat method. Evaluation will include safety precautions used, correct methods and tools used, neatness and general appearance of job.

I. Tools and materials

  A. Tubing cutter

  B. Reamer

  C. Sand cloth, emery cloth, steel wool

  D. Flux

  E. Torch

  F. Gas tank w/wrench

  G. Striker

  H. Wire solder

  I. Wiping cloth

  J. Tubing

  K. Fitting

  L. Colored safety glasses

II. Procedure

  A. Put on colored safety glasses

  B. Cut tubing to desired length

  C. Ream end of cut tubing

  D. Clean tubing end with sand cloth

  E. Clean fitting socket with sand cloth

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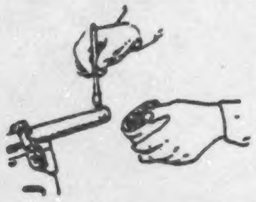
JOB SHEET #5

F. Apply thin coat of flux to tubing end and fitting socket (Figure 1)

(NOTE: A small brush used to apply the flux helps to keep out dirt.)

FIGURE 1



G. Insert tubing end into fitting socket

(NOTE: Twist the tubing while inserting in order to spread the flux evenly.)

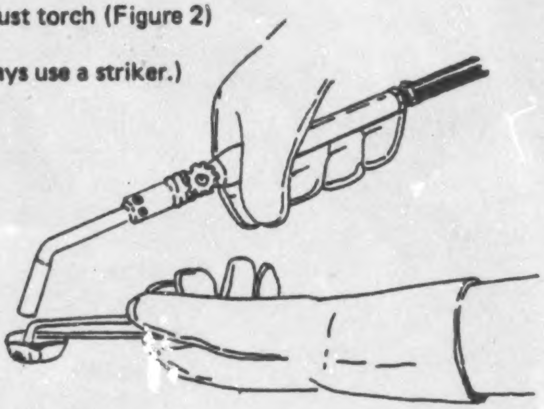
H. Clean away excess flux with cloth

I. Carefully secure tubing and fitting in vise

J. Light and adjust torch (Figure 2)

(NOTE: Always use a striker.)

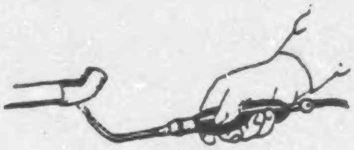
FIGURE 2



K. Apply heat to fitting (Figure 3)

(NOTE: The inner blue cone of the flame should be about 1/8" away from the fitting.)

FIGURE 3



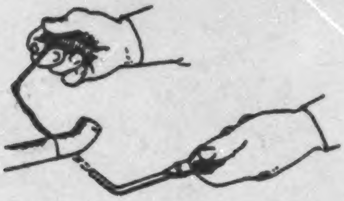
JOB SHEET #5

L. Move the torch flame around the entire joint

M. Apply solder (Figure 4)

(NOTE: Amount of solder is determined by size of tubing, i.e., 1/2" tubing will need approximately 1/2" wire solder, and 3/4" tubing 3/4" wire solder.)

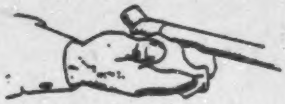
FIGURE 4



N. Discontinue heat and solder application when solder flows from joint

O. If necessary, wipe excess solder off with cloth (Figure 5)

FIGURE 5



P. Turn off torch

Q. Allow solder to cool

(NOTE: Do not apply water to cool the fitting.)

R. Clean up area and put tools away

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JOINING PIPES
UNIT III

JOB SHEET #6--CUT, REAM, AND JOIN COPPER TUBING USING A COMPRESSION JOINT

EVALUATION: Given access to tools, equipment and materials, cut, ream and join copper tubing using a compression joint. Evaluation will include safety precautions used, correct methods and use of tools, and general appearance of the job.

I. Tools and materials

   A. Tubing cutter

   B. Reamer

   C. Fitting

   D. Tubing

   E. Open-end wrench or flare-nut wrench

   F. Adjustable wrench

II. Procedures

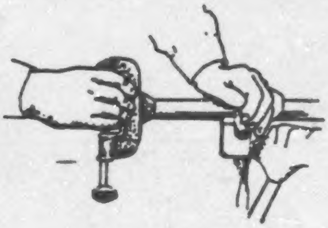
   A. Cut tubing to desired length

   B. Slip fitting nut and sleeve over end of tubing

   C. Ream end of tubing (Figure 1)

   (NOTE: If tubing is reamed before installing fitting sleeve, the sleeve might not fit over end of tubing.)

   FIGURE 1



   D. Insert end of tubing into fitting

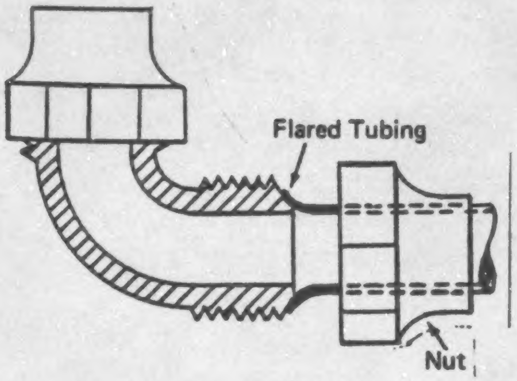
   (NOTE: Tubing end must fit snugly against bottom of fitting socket.)

   E. Slide fitting nut and sleeve up against threaded end of fitting

JOB SHEET #6

F. Make up nut hand-tight on fitting (Figure 2)

FIGURE 2



G. Hold body of fitting with adjustable wrench

H. Turn fitting nut with flare-nut wrench or open-end wrench

(NOTE: Keep tubing tight against bottom of fitting socket while tightening nut.)

I. Complete tightening of nut on fitting

J. Duplicate process on other end of fitting

K. Clean up area and put tools away

JOINING PIPES
UNIT III

JOB SHEET #7–CUT, REAM, AND JOIN COPPER TUBING USING A FLARE JOINT

EVALUATION: Given access to tools, equipment, and materials, cut, ream and join copper tubing using a flare joint. Evaluation will include safety precautions used, correct methods and use of tools, and general appearance of the job.

I. Tools and materials

   A. Tubing cutter

   B. Reamer

   C. Flaring tool and block

   D. Tubing

   E. Fitting

   F. Adjustable wrench

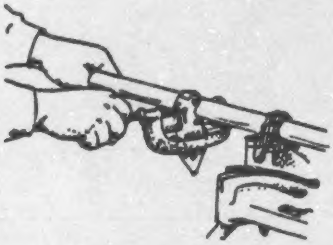
   G. Open-end or flare-nut wrench

II. Procedure

   A. Measure and cut a desired length of tubing

      1. Place cutter on tubing; do not overtighten (Figure 1)

FIGURE 1



      2. Turn a few revolutions and then tighten a little more

      3. Continue to tighten a little at a time while turning cutter

      (NOTE: Cutter should not be so tight that it bends the end of the tubing.)

   B. Slip flare nut over end of tubing

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JOB SHEET #7

C. Ream the end of the tubing

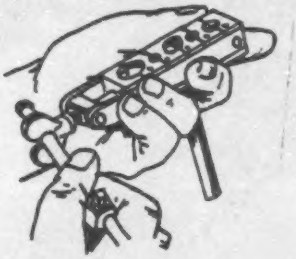
  1. Do not over-ream; just remove the burr

  2. Point end of tubing slightly downward while reaming to allow chip to fall out

D. Place tubing in flaring block

E. Extend end of tubing above the block face about 1/3 the depth of the block chamfer (Figure 2)

FIGURE 2



F. Secure tubing in flaring block

G. Place flaring tool on block

(NOTE: Flaring tool must be kept oiled and clean.)

H. Tighten cone into tubing a few turns and then back it out

I. Continue the tightening and loosening process until the flare is made

(NOTE: This process tends to make a smooth, polished flare and will lessen the chances of work hardening the tubing.)

J. Do not overtighten the flaring tool

(NOTE: This will cause the tubing to wash-out and possibly cause the flare to split.)

K. Remove flaring tool from block

L. Remove tubing from flaring block

M. Check fit of flare to seat of flare nut

N. Secure flare nut tightly to flare fitting

O. Duplicate process on other end of flare fitting

P. Clean up area and put tools away

JOB SHEET #8--CUT, REAM, AND JOIN COPPER TUBING USING A HAMMERED FLARE JOINT

EVALUATION: Given access to tools, equipment, and materials, cut, ream, and join copper tubing using a hammered flare joint. Evaluation will include safety precautions used, correct methods and use of tools, and general appearance of the job.

I. Tools and materials

   A. Tubing cutter

   B. Reamer

   C. Flaring tool

   D. Small ball peen hammer

   E. Fitting

   F. Tubing

   G. Adjustable wrench

   H. Open-end or flare nut wrench

II. Procedure

   A. Measure and cut a desired length of tubing

      1. Place cutter on tubing, do not overtighten

      2. Turn a few revolutions and then tighten a little more

      3. Continue to tighten a little at a time while turning cutter

      (NOTE: Cutter should not be so tight that it bends the end of the tubing.)

   B. Slip flare nut over end of tubing

   C. Ream the end of the tubing

      1. Do not over-ream; just remove the burr

      2. Point end of tubing slightly downward while reaming to allow chips to fall out

   D. Carefully clean inside end of tubing

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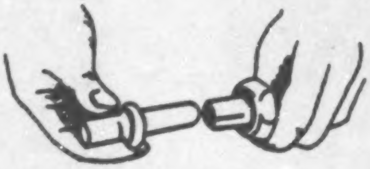
JOB SHEET #8

E. Carefully clean flaring tool

(NOTE: Flaring tool should be cleaned and oiled before and after use.)

F. Place end of flaring tool in end of pipe (Figure 1)

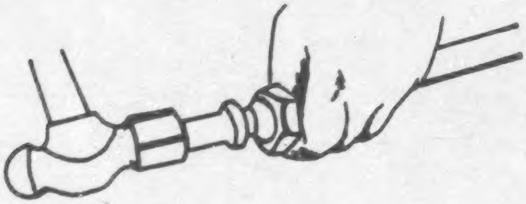
FIGURE 1



G. Holding tubing and flaring tool in one hand, drive flaring tool into tubing with hammer (Figure 2)

(NOTE: Tubing and flaring tool must be held straight.)

FIGURE 2



H. Drive flaring tool into tubing until desired flare is formed.

(NOTE: This may require checking flare on fitting.)

H. Remove flaring tool from tubing
(NOTE: This may require turning flaring tool in order to loosen it.)

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JOB SHEET #8

I. Check fit of flare to seat of flare nut

J. Secure flare nut tightly to flare fitting

K. Duplicate process on other end of flare fitting

L. Clean up area and put away tools

JOINING PIPES
UNIT III

JOB SHEET #9--CUT, REAM, AND JOIN P.V.C. PIPE TO A P.V.C. FITTING

EVALUATION: Given access to tools, equipment and materials, cut, ream and join P.V.C. pipe to a P.V.C. fitting. Evaluation will include accuracy of cut pipe, correct methods and tools used, neatness of job, and use of safety precautions.

I. Tools and materials

   A. Pipe cutter or handsaw with mitre box

   B. Reamer

   C. Cleaning solvent with brush or abrasive paper

   D. Solvent cement with brush

   E. Pipe

   F. Fitting

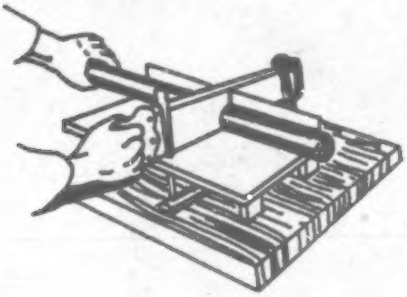
   G. Wiping cloth

II. Procedure

   A. Measure and cut pipe to desired length

   (NOTE: A mitre box and mitre saw insures a square cut. See Figure 1.)

   FIGURE 1



   B. Ream pipe

   (CAUTION: Since most P.V.C. reaming is done with a pocket knife or other types of knives, care must be exhibited in this operation.)

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JOB SHEET #9

C. Apply solvent cleaner to pipe end and fitting socket

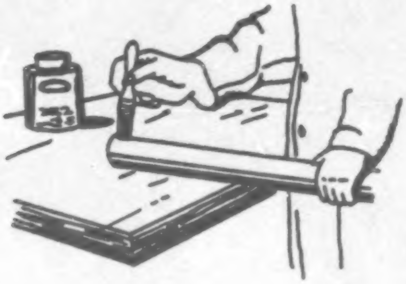
(NOTE: Abrasive paper such as sand cloth or emery cloth may be used.)

D. Wipe solvent cleaner from the pipe end and fitting socket

(NOTE: This cleans the pipe and removes the gloss for better bonding.)

E. Apply a light, even coat of solvent cement to the pipe end and fitting socket (Figure 2)

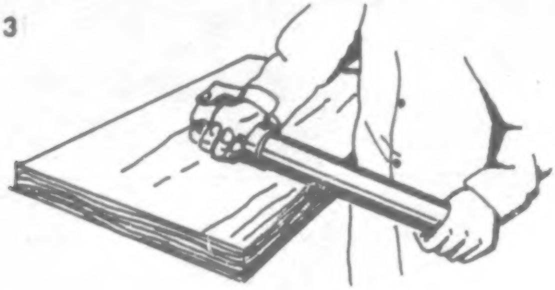
FIGURE 2



F. Insert pipe all the way into the fitting socket while giving it a quarter turn (Figure 3)

(NOTE: This operation must be done quickly as the cement sets-up in a few seconds.)

FIGURE 3



G. Allow 24 hours before testing P.V.C. joints

H. Clean up area and put tools away

JOINING PIPES
UNIT III

JOB SHEET #10–CUT, REAM AND JOIN FLEXIBLE PLASTIC PIPE WITH INSERT FITTINGS

EVALUATION: Given access to tools, equipment and materials, cut, ream and join flexible plastic pipe with insert fittings. Evaluation will include use of safety precautions, correct methods and tools used, and neatness of the job.

I. Tools and materials

  A. Pipe cutter, saw, or knife

  B. Reamer

  C. Pipe

  D. Fitting

  E. Clamps

  F. Screwdrivers

  G. Socket wrench

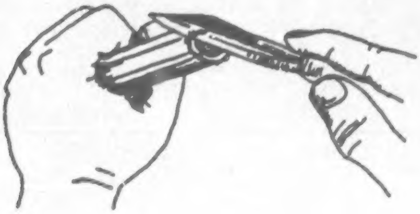
II. Procedures

  A. Measure and cut pipe to desired length

  B. Ream pipe (Figure 1)

  (CAUTION: Since most flexible plastic pipe is cut and reamed with a knife, care must be exhibited in this operation.)

  FIGURE 1



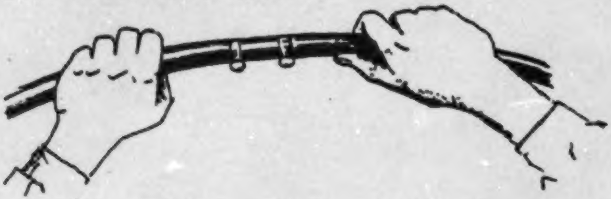
  C. Slip clamp over end of pipe

  (NOTE: Open clamp enough for it to fit loosely on the pipe.)

D. Holding pipe in one hand, and the fitting in the other, force fitting into end of pipe (Figure 2)

(NOTE: Cold (rigid) or heavy gauge pipe may need to be softened by hot water or a small flame from a torch.)

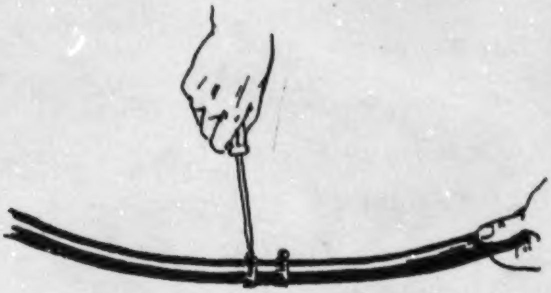
FIGURE 2



E. Slip clamp over inserted fitting and tighten with screwdriver (Figure 3)

(NOTE: Some clamps are fitted with hex nuts to accomodate socket wrenches.)

FIGURE 3



F. Complete same process on other end of fitting

G. Clean up area and put away tools

JOINING PIPES
UNIT III

JOB SHEET #11–JOIN CLAY PIPE WITH COUPLINGS

EVALUATION: Given a joint lubricant, lubricant brush, wiping rag, and hubless clay pipe, join two 5' sections of 6" diameter clay pipe. The completed joint must bond firmly with no leaks evident.

I. Tools and equipment

   A. Two 5' lengths of 6" diameter hubless clay pipe

   B. Joint lubricant

   C. Brush

   D. Wiping cloth

   E. Coupling

II. Procedure

   A. Clean pipe ends with rag

   B. Apply joint lubricant inside pipe coupling and outside bald end of pipe to be joined

   C. Place pipe coupling against bald end of pipe to be joined and press two ends together

   D. Clean up area and put materials away

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JOINING PIPES
UNIT III

JOB SHEET #12--WIPE CLAY PIPE JOINTS

EVALUATION: Given a flat surface, yarning iron, oakum, putty knife, and tar compound, wipe a 4" diameter clay pipe joint. Equal clearance between the spigot and the bell must be maintained, and the tar compound must be beveled smoothly along the joint.

I. Tools and equipment

   A. Yarning iron

   B. Oakum

   C. Putty knife

   D. Tar compound

   E. 2 lengths clay pipe

II. Procedure

   A. Position pipes on flat surface

   B. Slide spigot end into pipe bell

   C. Stuff oakum between spigot and bell with yarning iron, maintaining equal clearance between exterior of the spigot and the interior of bell.

   (NOTE: Leave 3/4" to 1" depth cavity in joint for tar compound application.)

   D. Fill joint cavity with tar compound-rolling approximately 1" extra material

   E. Bevel and smooth joint with hand or putty knife

   F. Clean up area and put equipment away

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JOB SHEET #13--CUT CAST IRON SOIL PIPE WITH SNAP-TYPE CHAIN CUTTER

EVALUATION: Using a snap-type chain cutter, cut 3" from a 3' length of 4" diameter cast-iron pipe. The tolerance in the length will be 1/4", and cut ends must be free of flakes.

I. Tools and equipment

   A. 6' rule or steel tape

   B. Snap-type chain cutter

   C. Marking soap

   D. Ball peen hammer

II. Procedure

   A. Measure and mark length to be cut

   B. Stretch chain on cutter and wrap it securely around pipe at point marked previously

   C. Lock chain cutter in place

   D. Briskly depress cutter handles until pipe falls apart

   E. Chip flakes from cut ends with a hammer.

   (NOTE: This is necessary when using gasket joints.)

   F. Clean up area and put equipment away

JOB SHEET #14--BEND COPPER TUBING WITH A SPRING BENDER

EVALUATION: Given access to tools, equipment and materials, bend copper tubing with a spring bender. Evaluation will include accuracy of bend, neatness of bend, and use of correct methods.

I. Tools and equipment

   A. Approximately two feet of 1/2" diameter copper tubing

   B. 1/2" spring bender

II. Procedure

   A. Slide tubing bender over tubing to proper location for bend

   B. Firmly grip one end of the bending spring with one hand and pull the opposite end toward your body at the approximate angle desired

   (NOTE: Both thumbs must nearly touch each other.)

   C. Check angle of accuracy to the specific required angle

   D. Repeat step B if adjustments need to be made

   (NOTE: The bending spring is not a precision tool; experience and judgment are needed to acquire accuracy.)

   E. Clean up area and put materials away

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JOB SHEET #15–THREAD STEEL PIPE WITH ADJUSTABLE DIE

EVALUATION: Using an adjustable die and a pipe vise, cut threads on one end of a 1" diameter steel pipe 3' in length. The completed threads must be free of nicks and burrs.

I. Tools and equipment

   A. Adjustable stock and die

   B. Cutting oil and oil can

   C. Drip pan

   D. Pipe vise

   E. 1" diameter pipe, 3' long

II. Procedure

   A. Secure pipe in vise

   B. Place round guide end of pipe die stock on pipe end to be threaded

   C. Press dies against pipe end with heel of hand

   (NOTE: Hold hand against dies while taking short, clockwise strokes to begin thread-cutting operation.)

   D. Continue cutting threads until appropriate number of threads project from outside edge of dies

   (NOTE: Keep die stock oiled during threading process.)

   E. Reverse threader and remove dies from threaded end of pipe

   F. Clean up area and put equipment away

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JOB SHEET #16--JOIN CAST IRON PIPE TO CLAY PIPE

EVALUATION: Given access to tools, equipment, and materials, join a cast iron pipe to a clay pipe. Evaluation will include correct methods used and neatness and appearance of job.

I. Tools and equipment

  A. Short length of cast iron pipe

  B. Short length of clay pipe

  (NOTE: The clay pipe should be the same size as the cast iron pipe.)

  C. Yarning iron

  D. Packing iron

  E. Small trowel

  F. Clean bucket

  G. Sand and cement

  H. Clean cloth

  I. Safety glasses

II. Procedure

  A. Insert spigot end of cast iron pipe into hub end of clay pipe.

  (NOTE: Wipe hub and spigot clean and dry to assure tight bond of cement.)

  B. Yarn and pack oakum into joint

  C. Mix sand and cement with water (3 parts sand, 1 part cement.)

  D. Pack cement into joint and smooth with trowel

  E. Wipe off excess cement from joint

  F. Ask instructor for evaluation

  G. Clean up area and put equipment away

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JOINING PIPES
UNIT III

NAME ______________________

TEST

1. Match the terms on the right to the correct definitions.

______a. Method of using a solvent to join P.V.C. pipe

______b. Method of joining copper tubing using flux and solder applied with heat

______c. Removing burrs from inside edge of pipe

______d. Type of cast iron pipe to be joined by special fittings

______e. Cutting spiral grooves on the end of pipe to facilitate joining with a fitting or another pipe

______f. Method of joining cast iron pipe fittings using lead and oakum

______g. Substance applied to pipe threads to help seal the joint

______h. Expanded end of cast iron pipe which receives the spigot end of pipe or fitting

______i. Method of joining flexible plastic pipe

______j. End of fitting a pipe which is inserted into hub (or bell)

______k. Insert in cast iron hub which makes up part of a water tight compression joint

1. Caulking
2. Threading
3. Cementing
4. Insert joining
5. Reaming
6. No-hub
7. Neoprene gasket
8. Hub
9. Spigot end
10. Pipe compound (dope)
11. Sweating

2. Select tools, materials, and equipment necessary to join steel pipe by placing an "X" in the appropriate blanks.

______a. Cutter

______b. Reamer

______c. Open end wrench

_____d. Oil can

_____e. Aviation wire snips

_____f. Pipe vise

_____g. Adjustable stock-and-die set

_____h. Screwdriver

_____i. Pipe dope

_____j. Paint

_____k. Pipe wrench

_____l. Pipe

_____m. Fitting

3. Select tools, materials, and equipment necessary to join cast iron pipe by the caulking, compression, and no-hub method by placing an "X" in the appropriate blanks.

a. Caulking method

_____1. Pipe cutter

_____2. Pipe dope

_____3. Yarning irons

_____4. Lead pot

_____5. Oil can

_____6. Ladle

_____7. Hammer

_____8. Asbestos joint runner

_____9. Reamer

_____10. Lead

_____11. Oakum

_____12. Pipe

_____13. Safety glasses

b. Compression method

______1. Neoprene gasket

______2. Fitting

______3. Gasket lubricant

______4. Lead hammer

______5. Lead

______6. Pipe puller

c. No-hub method

______1. Neoprene gasket

______2. Stainless steel shield-and-clamp assembly

______3. Lead hammer

______4. Socket wrench

______5. Pipe

______6. Fitting

4. Select tools, materials, and equipment necessary to join copper tubing by the sweat joint, compression and flare methods by placing an "X" in the appropriate blank.

a. Sweat joint method

______1. Tubing cutter

______2. Fitting

______3. Gas tank with wrench

______4. Open-end wrench

______5. Flux with brush

______6. Sand cloth, emery cloth, steel wool

______7. Solvent cement

______8. Wire solder

______9. Tubing

______10. Handsaw

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______11. Torch

______12. Striker

b. Compression method

______1. Tubing cutter

______2. Wire solder

______3. Reamer

______4. Flare-nut wrench

______5. Tubing

______6. Fitting

c. Flare method

______1. Tubing cutter

______2. Torch

______3. Flaring tool and block

______4. Cleaning solvent

______5. Reamer

______6. Flare-nut wrench

______7. Adjustable wrench

5. Select tools, materials, and equipment necessary to join P.V.C. and flexible plastic pipe by placing an "X" in the appropriate blanks.

a. P.V.C. pipe

______1. Handsaw with mitre box

______2. Reamer

______3. Clamp

______4. Screwdriver

______5. Solvent cement with brush

______6. Pipe

______7. Cleaning solvent with brush

b. Flexible plastic pipe

______1. Reamer

______2. Pipe

______3. Clamp

______4. Socket wrench

______5. Solvent cement

______6. Flaring tool and block

______7. Pipe cutter

6. Demonstrate the ability to:

   a. Cut, ream, thread and join a piece of 1" galvanized steel pipe to a 1" galvanized steel fitting.

   b. Measure, cut, and join cast iron pipe to a cast iron fitting using the caulking method.

   c. Join cast iron pipe to a cast iron fitting using a no-hub joint.

   d. Join cast iron pipe to a cast iron fitting using a compression joint.

   e. Cut, ream, and join copper tubing using the sweat method.

   f. Cut, ream, and join copper tubing using a compression joint.

   g. Cut, ream, and join copper tubing using a flare joint.

   h. Cut, ream, and join copper tubing using a hammered flare joint.

   i. Cut, ream, and join P.V.C. pipe to a P.V.C. fitting.

   j. Cut, ream, and join flexible plastic pipe with insert fittings.

   k. Join clay pipe with couplings.

   l. Wipe clay pipe joints.

   m. Cut cast iron soil pipe with snap-type chain cutter.

   n. Bend copper tubing with a spring bender.

   o. Thread steel pipe with adjustable die.

   p. Join cast iron pipe to clay pipe.

   (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

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JOINING PIPES
UNIT III

ANSWERS TO TEST

1. a. 3
   b. 11
   c. 5
   d. 6
   e. 2
   g. 10
   h. 8
   i. 4
   j. 9
   k. 7

2. a, b, d, f, g, i, k, l, m

3. a. 1, 3, 4, 6, 7, 8, 10, 11, 12, 13
   b. 1, 2, 3, 4, 6
   c. 1, 2, 4, 5, 6

4. a. 1, 2, 3, 5, 6, 8, 9, 11, 12
   b. 1, 3, 4, 5, 6
   c. 1, 3, 5, 6, 7

5. a. 1, 2, 5, 6, 7
   b. 1, 2, 3, 4, 7

6. Performance skills evaluated to the satisfaction of the instructor

PIPE FITTINGS
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify pipe fittings used in residential plumbing. The student should also be able to demonstrate the ability to designate specific applications for these fittings. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with pipe fittings to the correct definitions or descriptions.
2. Match the materials used to make plumbing fittings with specific uses, types, and properties.
3. Identify basic plumbing branches.
4. Identify basic plumbing bends.
5. Identify basic unions and couplings.
6. Identify basic caps and plugs.
7. Identify basic bushings and nipples.
8. Identify basic closet flanges and clean-outs.
9. Identify basic no-hub fittings.
10. Identify flexible plastic (PE) insert fittings.
11. Describe two types of malleable iron fittings.
12. Select four types of adapters.
13. Demonstrate the ability to:
    a. Read fitting sizes.
    b. Identify fittings from a sketch of a piping system.

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PIPE FITTINGS
UNIT IV

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and assignment sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information and assignment sheets.

   F. Conduct tour of plumbing supply storage.

   G. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete assignment sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Basic Plumbing Branches

      2. TM 2--Basic Plumbing Bends

      3. TM 3--Basic Plumbing Fittings

      4. TM 4--Basic Plumbing Fittings (Continued)

      5. TM 5--Flexible Plastic Pipe (PE) Insert Fittings

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D. Assignment sheets

   1. Assignment Sheet #1–Read Fitting Sizes

   2. Assignment Sheet #2–Identify Fittings from a Sketch of a Piping System

E. Answers to assignment sheets

F. Test

G. Answers to test

II. References:

   A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, IL: Goodheart-Willcox, 1978.

   B. *Naval Training Command: Rate Training Manual, Utilitiesman 3 and 2.* Washington, DC: U.S. Government Printing Office, 1973.

   C. *National Plumbing Code Illustrated.* St. Petersburg, FL: Manus Publishing, 1973.

III. Additional references:

   A. *Building Construction.* Columbia, MO: University of Missouri-Columbia/Instructional Materials Laboratory, 1976.

   B. Ludwig, Oswald A., and Willard McCarthy and Victor Repp. *Metalwork Technology and Practice.* Bloomington, IL: McKnight Publishing, 1975.

   C. Manufacturers catalogs

PIPE FITTINGS
UNIT IV

INFORMATION SHEET

I. Terms and definitions or descriptions

- A. Fittings--Those parts of the piping system which are used to join pipes and tubes

  (NOTE: Valves are not usually considered fittings.)

- B. Adapter--Type of fitting which joins pipes of different materials
- C. Bushing--Fitting used to reduce size
- D. Joint--The connection of pipe to fitting or any combination of fittings and pipes
- E. Pipe joint compound--A substance used on threaded joints to help make them tight, to lubricate them, and to fill in imperfections

  (NOTE: Pipe joint compound is sometimes referred to as dope.)

- F. Drainage fitting--Fitting designed especially for drainage, allowing the connecting pipe a 2° pitch
- G. Pressure fitting--Fitting designed to withstand specified pressure
- H. Fitting gain--That space which the pipe requires in the fitting
- I. Malleable iron fittings--Fittings which have been annealed to reduce brittleness
- J. Oakum--Loosely woven hemp rope which has been treated with a water proofing substance and is used to make caulked joints in cast iron pipe systems
- K. FPT--Female pipe thread
- L. MPT--Male pipe thread
- M. Malleable--Lack of brittleness
- N. Rigid--Inflexible
- O. Thread tape--Substitute for pipe compound

  (NOTE: Thread tape is often Teflon tape.)

INFORMATION SHEET

II. Uses, types, and properties of materials used to make pipe fittings

A. Cast iron

1. Uses
    a. Drains, sewers
    b. Vents
2. Types
    a. Hub and spigot
    b. No-hub
3. Properties
    a. Very brittle, cannot withstand rough treatment or it will easily break
    b. Rigid
    c. Heavy, needs strong support or base

B. Copper

1. Uses
    a. Water services and distribution
    b. Drainage (above ground)
    c. Vents
    d. Gas (LPG)
2. Types
    a. Wrought
    b. Cast (Brass)
3. Properties
    a. Fairly malleable
    b. Rigid
    c. Light weight, needs light support

INFORMATION SHEET

C. Plastic

1. Uses
    - a. Drains
    - b. Vents
    - c. Water services
    - d. Irrigation
2. Types
    - a. P.V.C.-Polyvinyl chloride
    - b. P.E.-Polyethylene

      (NOTE: Check other types of plastic in your locality.)
3. Properties
    - a. Very malleable
    - b. P.V.C. is fairly rigid
    - c. P.E. is fairly flexible
    - d. Light weight, needs light support

D. Malleable cast iron

1. Uses
    - a. Gas pipe (black)
    - b. Drains (galvanized)
    - c. Vents (galvanized)
    - d. Water service and distrubution (galvanized)
2. Types
    - a. Black iron
    - b. Galvanized
3. Properties
    - a. Fairly malleable

      (NOTE: Threads can be easily damaged.)

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      b. Rigid
      c. Heavy, needs strong support or base
      d. Tends to rust

E. Brass
   1. Uses
      a. Gas lines
      b. Water services and distribution
   2. Types
      a. Compression
      b. Flare
   3. Properties
      a. Fairly malleable

         (NOTE: Threads can be easily damaged.)

      b. Rigid
      c. Light weight, needs little support

F. Vitrified clay
   1. Uses
      a. House sewer
      b. City sewer
   2. Type--Hub (bell) and spigot: plain end with coupling
   3. Properties
      a. Very brittle

         (NOTE: Vitrified clay pipe cannot withstand rough treatment or it will break.)

      b. Rigid
      c. Medium weight

         (NOTE: Vitrified clay pipe is always installed underground, and it needs a firm, even base.)

INFORMATION SHEET

III. Basic plumbing branches (Transparency 1)

- A. Tee
- B. Double tee
- C. Tapped tee
- D. Double tapped tee
- E. Sanitary tee
- F. Long turn sanitary tee (combination Y and 1/8 bend)
- G. Double sanitary tee
- H. Test tee
- I. Wye
- J. Double wye
- K. Male adapter
- L. Female adapter

(NOTE: Copper and plastic adapters are threaded for iron pipe size (IPS).)

IV. Basic plumbing bends (Transparency 2)

- A. Short turn
- B. Medium turn
- C. Long turn
- D. Quarter (1/4) = 90°
- E. Fifth (1/5) = 72°
- F. Sixth (1/6) = 60°
- G. Eighth (1/8) = 45°
- H. Sixteenth (1/16) = 22.5°
- I. Street elbow (male)
- J. Adapter elbow (female)
- K. Drop-ear elbow (copper to FIP)

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INFORMATION SHEET

V. Basic unions and couplings (Transparency 3)

  A. Unions

    1. Straight
    2. Ground joint
    3. Gasket type
    4. Dielectric

  B. Couplings

    1. Straight
    2. Reducing
    3. Male to female adapter

VI. Basic caps and plugs (Transparency 4)

  A. Caps

    1. Cast iron
    2. Test cap (copper)

  B. Plugs

    1. Cored
    2. Solid

VII. Basic bushings and nipples (Transparency 4)

  A. Bushings

    1. Copper
    2. Malleable face bushing

  B. Nipples

    1. Close
    2. Shoulder
    3. Long

INFORMATION SHEET

VIII. Basic closet flanges and clean-outs (Transparency 4)

- A. Closet flanges
  - 1. No-hub slot and notch
  - 2. P.V.C.
- B. Clean-outs
  - 1. P.V.C.
  - 2. Cast iron

IX. Basic no-hub fittings (Transparency 4)

- A. Wye
- B. Sanitary tee
- C. Long turn quarter bend

X. Flexible plastic (PE) insert fittings (Transparency 5)

- A. Tee
- B. Tapped tee
- C. 90° elbow
- D. 90° female adapter elbow
- E. Coupling
- F. Male adapter
- G. Male steel adapter
- H. Clamp

XI. Two types of threaded iron fittings

- A. Pressure
  - 1. Used for water, gas, air vent lines

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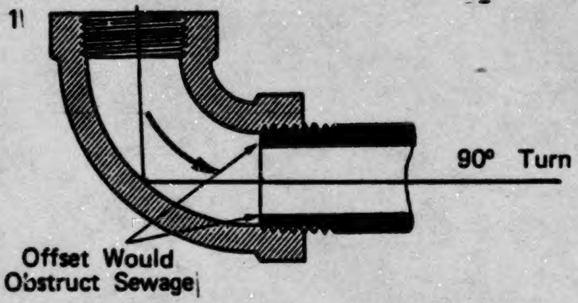
INFORMATION SHEET

2. Fittings are designed for absolute degree turns (Figure 1)

Figure 1


90° Turn
Offset Would Obstruct Sewage

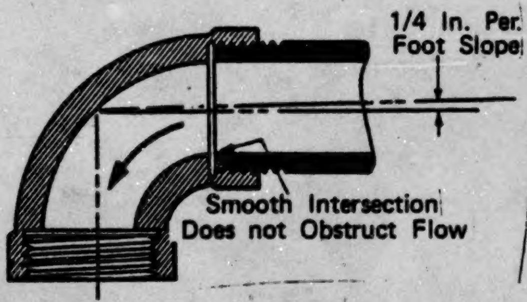
✓

B. Drainage

1. Used for drainage

2. Fittings are designed for drainage and tapped with a pitch of 1/4" per foot (Figure 2)

Figure 2


1/4 In. Per Foot Slope
Smooth Intersection Does not Obstruct Flow

3. Minimum size manufactured is 1 1/4"

4. The inside of drainage fittings are smooth and shaped for easy flow

   (NOTE: Compare Figures 1 and 2.)

XII. Types of adapters

A. Copper

1. Copper to cast iron (caulked)
2. Copper to threaded pipe

B. P.V.C. Plastic (Transparency 6)

1. P.V.C. to cast iron
2. P.V.C. to threaded pipe

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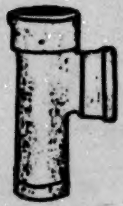
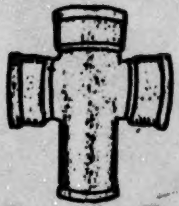
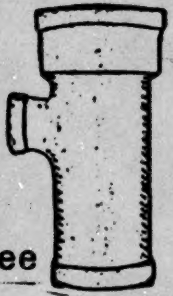
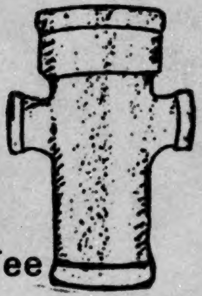
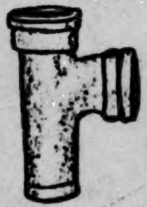
Basic Plumbing Branches

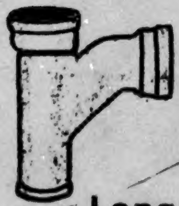

Tee

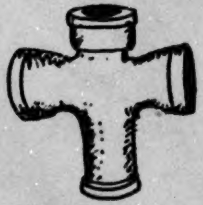

Double Tee

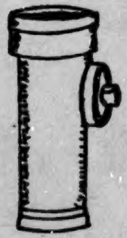

Tapped Tee

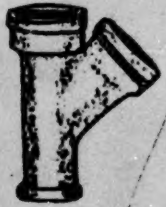

Double
Tapped Tee

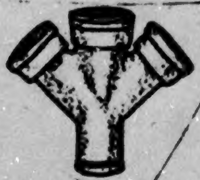

Sanitary Tee

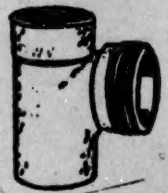

Long Turn
Sanitary Tee
(Combination Y and 1/8 Bend)

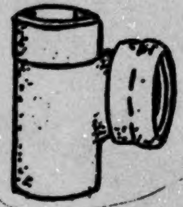

Double Sanitary Tee


Test Tee


WYE

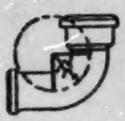

Double WYE


Male Adapter
Copper

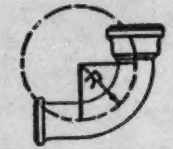

Female Adapter
Copper

Basic Plumbing Bends

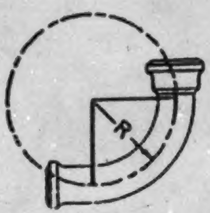
Quarter Bends (90°)



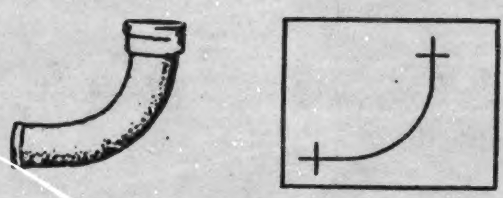
Short Turn



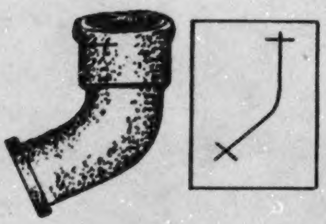
Medium Turn



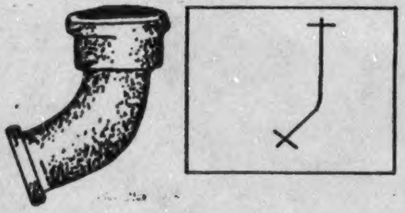
Long Turn



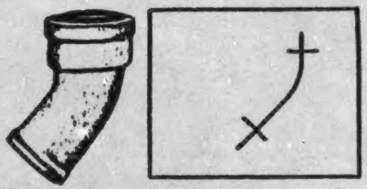
1/4 Bend = 90°



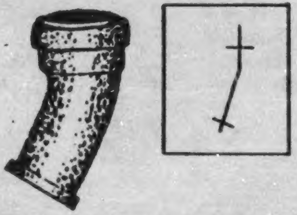
1/5 Bend = 72°



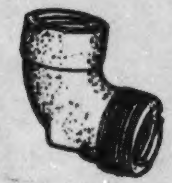
1/6 Bend = 60°



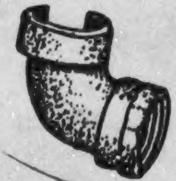
1/8 Bend = 45°



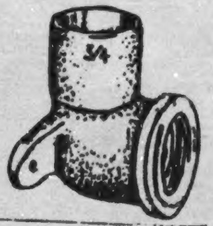
1/16 Bend = 22.5°



Male Street Elbow
(copper)



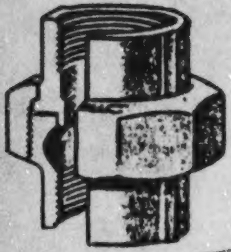
Female Adapter Elbow
(copper)



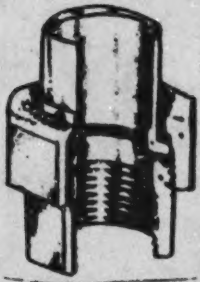
Drop-Ear Elbow
(copper to fip)

Basic Plumbing Unions and Couplings

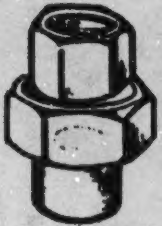
Unions



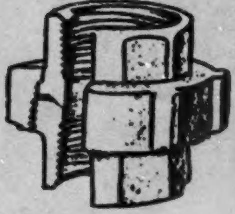
Gasket Type
(Malleable Galvanized Iron)



Dielectric
(Copper)

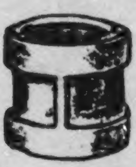


Straight
(Copper to Copper)

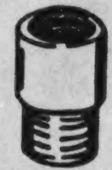


Ground Joint
(Malleable Galvanized Iron)

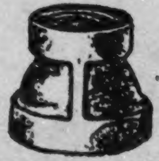
Couplings



Straight



Adapter
Male to Female

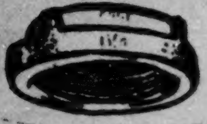


Reducing

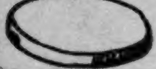
Basic Plumbing Fittings

Basic Caps and Plugs

Caps

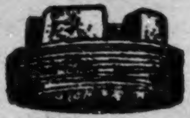


Cast Iron

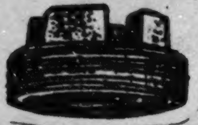


Test Cap (Copper)

Plugs



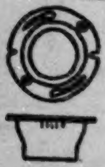
Solid



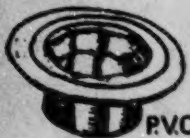
Cored

Basic Closet Flanges and Clean-Outs

Closet Flanges

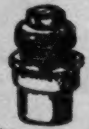


No-Hub Slot and Notch

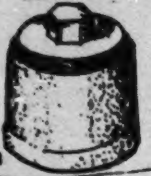


P.V.C.

Clean-Outs



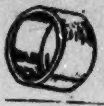
Copper



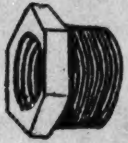
Cast Iron

Basic Bushings and Nipples

Bushings

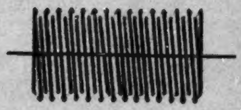


Copper

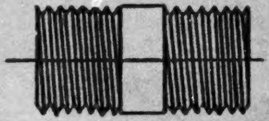


Malleable cast iron

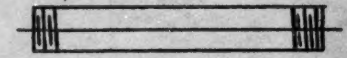
Nipples



Close

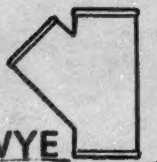


Shoulder

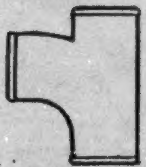


Long

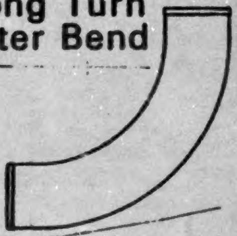
Basic No-Hub Fittings



WYE

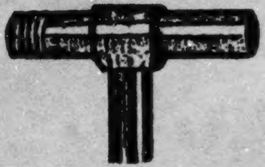


Sanitary Tee

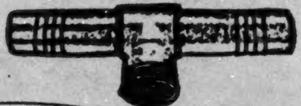


Long Turn Quarter Bend

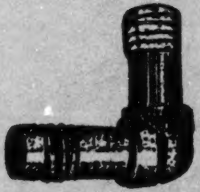
Flexible Plastic Pipe (PE) Insert Fittings



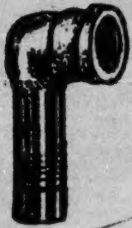
Tee



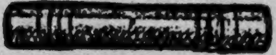
Tapped Tee



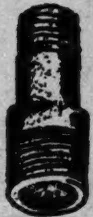
90º - Elbow



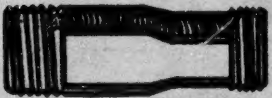
90º
Female Adapter



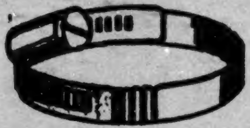
Coupling



Male
Adapter



Male
Steel Adapter



Clamp

PIPE FITTINGS
UNIT IV

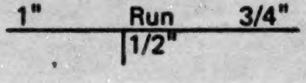
ASSIGNMENT SHEET #1–READ FITTING SIZES (Transparency 12)

Directions: Fittings are read size, material, type

Example:

A. Size--Largest size in the run is read first, followed by smallest size, if any, and the branch or "bull" last (Figure 1)

Figure 1



1" x 3/4" x 1/2"

B. Material--Indicate galvanized iron, copper, cast iron, etc.

C. Type--Identify as a tee, elbow, reducer, etc. The fitting in "A" might be read as:

1" x 3/4" x 1/2" galvanized iron tee

1. The main water distribution pipe is 3/4 inch galvanized pipe. Two 1/2 inch galvanized iron pipes are to be installed, one for the kitchen sink, the other for the washing machine. Read the fitting appropriate to connect these pipes. (Figure 2)

ANSWER____________

Figure 2

2. The same situation (question #1) but use rigid copper tubing. Read the fitting necessary.

ANSWER____________

3. A one inch galvanized iron water distribution pipe has a 1/2 inch side outlet for an outside hose bib. Read the fitting. (Figure 3)

ANSWER____________

Figure 3

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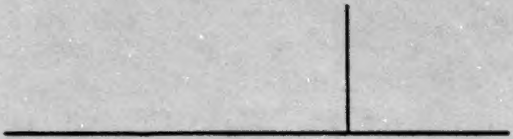
ASSIGNMENT SHEET #1

4. A 3/4 inch copper water distribution pipe is to supply the second floor and continue on to supply a laundry tray. Read the fitting necessary. (Figure 4)

ANSWER________________

Figure 4



PIPE FITTINGS
UNIT IV

ASSIGNMENT SHEET #2–IDENTIFY FITTINGS FROM A SKETCH OF A PIPING SYSTEM

A. ________

B. ________

C. ________

D. ________

E. ________

F. ________

G. ________

H. ________

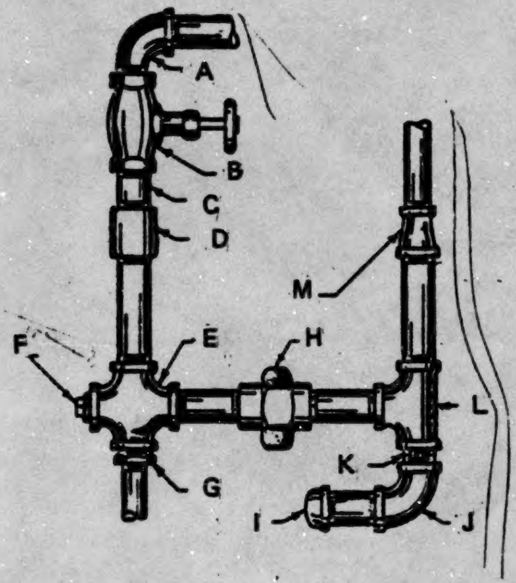
I. ________

J. ________

K. ________

L. ________

M. ________


A
B
C
D
M
E
H
F
L
K
G
I
J

PIPE FITTINGS
UNIT IV

ANSWERS TO ASSIGNMENT SHEETS

1. A. 3/4" x 1/2" x 1/2" galvanized iron tee
   B. 3/4" x 1/2" x 1/2" copper tee
   C. 1" x 1/2" galvanized iron tee
   D. 3/4" x 1/2" x 3/4" copper tee
2. A. Street elbow
   B. Globe valve
   C. Short nipple
   D. Coupling
   E. Cross
   F. Plug
   G. Bushing
   H. Union
   I. Cap
   J. Elbow
   K. Close nipple
   L. Tee
   M. Reducing coupling

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PIPE FITTINGS
UNIT IV

NAME______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Those parts of the piping system which are used to join pipes and tubes

_____b. Type of fitting which joins pipes of different materials

_____c. Fitting used to reduce size

_____d. The connection of pipe to fitting or any combination of fittings and pipes

✓ _____e. A substance used on threaded joints to help make them tight, to lubricate them, and to fill in imperfections

_____f. Fitting designed especially for drainage, allowing the connecting pipe a 2° pitch

_____g. Fitting designed to withstand specified pressure

_____h. That space which the pipe requires in the fitting

_____i. Fittings which have been annealed to reduce brittleness

_____j. Loosely woven hemp rope which has been treated with a water proofing substance and is used to make caulked joints in cast iron pipe systems

_____k. Female pipe thread

_____l. Male pipe thread

_____m. Lack of brittleness

_____n. Inflexible

_____o. Substitute for pipe compound

1. Malleable iron fittings
2. Pressure fitting
3. FPT
4. Pipe joint compound
5. Adapter
6. Fitting gain
7. MPT
8. Oakum
9. Drainage fitting
10. Joint
11. Bushing
12. Fittings
13. Rigid
14. Thread tape
15. Malleable

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2. Match the various materials used to make plumbing fittings with specific uses, types, and properties.

_____a. 1) Uses
  - a) Drains, Sewers
  - b) Vents

  2) Types
  - a) Hub and spigot
  - b) No-hub

  3) Properties
  - a) Very brittle, cannot withstand rough treatment or it will easily break
  - b) Rigid
  - c) Heavy, needs strong support or base

_____b. 1) Uses
  - a) Water services and distribution
  - b) Drainage (above ground)
  - c) Vents
  - d) Gas (LPG)

  2) Types
  - a) Wrought
  - b) Cast (brass) —

  3) Properties
  - a) Fairly malleable
  - b) Rigid
  - c) Light weight, needs light support

1. Plastic
2. Malleable cast iron
3. Cast iron
4. Vitrified clay
5. Copper
6. Brass

_____c. 1) Uses

- a) Drains
- b) Vents
- c) Water services
- d) Irrigation

2) Types

- a) P.V.C.-Polyvinyl chloride
- b) P.E.-Polyethylene

3) Properties

- a) Very malleable
- b) P.V.C. is fairly ridgid
- c) P.E. is fairly flexible
- d) Light weight, needs light support

_____d. 1) Uses

- a) Gas pipe (black)
- b) Drains (galvanized)
- c) Vents (galvanized)
- d) Water service and distribution (galvanized)

2) Types

- a) Black iron
- b) Galvanized

3) Properties

- a) Fairly malleable
- b) Ridgid
- c) Heavy, needs strong support or base
- d) Tends to rust

P-2-I-

_____e. 1) Uses

a) Gas lines

b) Water services and distribution

2) Types

a) Compression

b) Flare

3) Properties

a) Fairly malleable

b) Rigid

c) Light weight, needs little support

_____f. 1) Uses

a) House sewer

b) City sewer

2) Type--Hub (bell) and spigot; plain with coupling

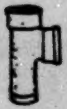
3) Properties

a) Very brittle

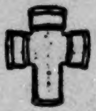
b) Rigid

c) Medium weight

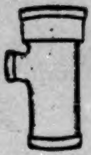
3. Identify basic plumbing branches.



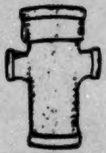
a. ____________



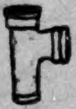
b. ____________



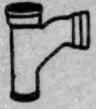
c. ____________



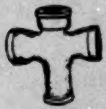
d. ____________



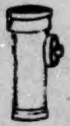
e. ____________



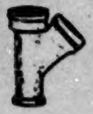
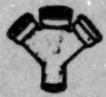
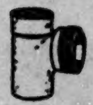
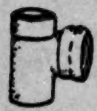
f. ____________



g. ____________

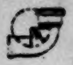
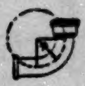
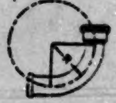
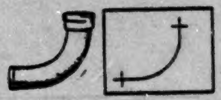


h. ____________

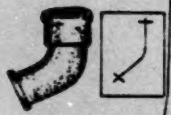
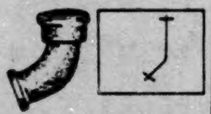
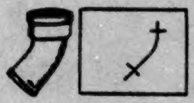
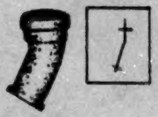





i. ______________ j. ______________ k. ______________ l. ______________

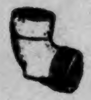
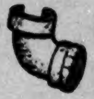
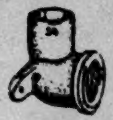
4. **Identify basic plumbing bends.**

a. ______________ b. ______________ c. ______________ d. ______________

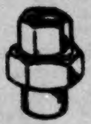
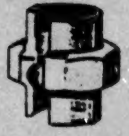
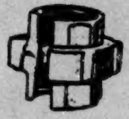
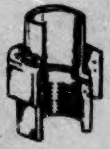





e. ______________ f. ______________ g. ______________ h. ______________

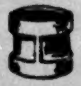
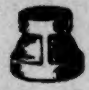
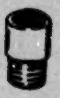




i. ______________ j. ______________ k. ______________

5. **Identify basic unions and couplings.**

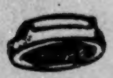
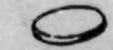
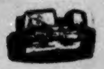
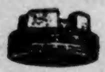





a. ______________ b. ______________ c. ______________ d. ______________

e. ______________ f. ______________ g. ______________

6. **Identify basic caps and plugs.**

a. ______________ b. ______________ c. ______________ d. ______________

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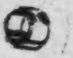
7. Identify basic bushings and nipples.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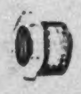
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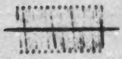
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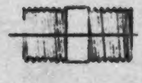
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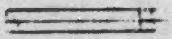
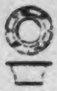

e. ____________

8. Identify basic closet flanges and clean-outs.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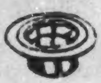
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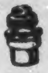
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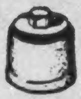
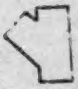

d. ____________

9. Identify basic no-hub fittings.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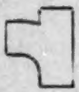
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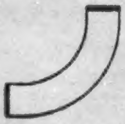
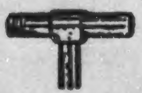
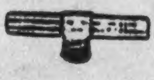

c. ____________

10. Identify flexible plastic (PE) insert fittings.


a. ____________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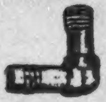
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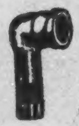
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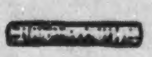
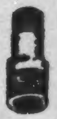
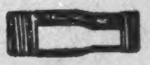
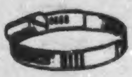

e. ____________


f. ____________


g. ____________


h. ____________

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11. Describe two types of malleable iron fittings.

a.

b.

12. Select four types of adapters by placing an "X" in the appropriate blanks.

_____a. Copper to cast iron (caulked)

_____b. Copper to threaded pipe

_____c. Copper to P.V.C.

_____d. P.V.C. to vitrified clay

_____e. P.V.C. to cast iron

_____f. P.V.C. to threaded pipe

13. Demonstrate the ability to:

a. Read fitting sizes.

b. Identify fittings from a sketch of a piping system.

(NOTE: If these activities have not been accomplished prior to the test, ask your instructor for a completion date.)

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PIPE FITTINGS
UNIT IV

ANSWERS TO TEST

1. a. 12
   b. 5
   c. 11
   d. 10
   e. 4
   f. 9
   g. 2
   h. 6
   i. 1
   j. 8
   k. 3
   l. 7
   m. 15
   n. 13
   o. 14

2. a. 3
   b. 5
   c. 1
   d. 2
   e. 6
   f. 4

3. a. Tee
   b. Double tee
   c. Tapped tee
   d. Double tapped tee
   e. Sanitary tee
   f. Long turn sanitary tee (combination Y and 1/8 bend)
   g. Double sanitary tee
   h. Test tee
   i. Wye
   j. Double wye
   k. Male adapter
   l. Female adapter

4. a. Short turn bend
   b. Medium turn bend
   c. Long turn bend
   d. 1/4 bend (90°)
   e. 1/5 bend (72°)
   f. 1/6 bend (60°)
   g. 1/8 bend (45°)
   h. 1/16 bend (22.5°)
   i. Male street elbow
   j. Female adapter elbow
   k. Drop-ear elbow

5. a. Straight union
   b. Gasket type union
   c. Ground joint union
   d. Dielectric union
   e. Straight coupling
   f. Reducing coupling
   g. Male to female adapter coupling

6. a. Cast iron cap
    b. Test cap (copper)
    c. Solid plug
    d. Cored plug
7. a. Copper bushing
    b. Cast iron hex bushing
    c. Close nipple
    d. Shoulder nipple
    e. Long nipple
8. a. No-hub slot and notch flange
    b. P.V.C. flange
    c. Copper clean-out
    d. Cast iron clean-out
9. a. Wye
    b. Sanitary tee
    c. Long turn quarter bend
10. a. Tee
    b. Tapped tee
    c. 90° elbow
    d. 90° female adapter elbow
    e. Coupling
    f. Male adapter
    g. Male steel adapter
    h. Clamp
11. Description should include:
    a. Pressure
        1) Used for water, gas, air vent lines
        2) Fittings are designed for absolute degree turns
    b. Drainage
        1) Used for drainage
        2) Fittings are designed for drainage and tapped with a pitch of 1/4" per foot
        3) Minimum size manufactured is 1 1/4"
        4) The inside of drainage fittings are smooth and shaped for easy flow
12. a, b, e, f
13. Demonstrated to the satisfaction of the instructor

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PIPE
UNIT V

UNIT OBJECTIVE

After completion of this unit, the student should be able to select types of pipe used in residential plumbing. The student should also be able to list the advantages and disadvantages of P.V.C. pipe, discuss the differences between black steel and galvanized steel pipe, and list the applications of various pipes in the plumbing trade. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment sheets and by scoring 85 percent on the unit test

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with pipes to the correct definitions or descriptions.
2. Select the types of pipes used in residential plumbing.
3. Match types of copper pipe to the correct identification colors.
4. List applications for types of pipes to be used in the plumbing trade.
5. Discuss the differences between black steel and galvanized steel pipe.
6. List four advantages and two disadvantages of P.V.C. pipe.
7. Discuss the three common methods of measuring pipe when given illustrations.
8. Construct a materials take-off list from an isometric drawing.
9. Secure a permit for the installation of a plumbing system.

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide student with objective sheet.
- B. Provide student with information and assignment sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information sheet.
- F. Conduct a tour of the pipe supply storage room.
- G. Conduct a tour of the school's piping systems.

  (NOTE: Use the local plumbing code book as a guide.)
- H. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete assignment sheets.
- D. Complete activities assigned by instructor.
- E. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet

C. Transparency masters

   1. TM 1--Steel and Cast Iron Pipe

   2. TM 2--Types of Pipe (Continued)

   3. TM 3--Types of Pipe (Continued)

D. Assignment Sheets

   1. Assignment Sheet #1--Construct a Materials Take-Off List from an Isometric Drawing

   2. Assignment Sheet #1--Secure a Permit for an Installation of a Plumbing System

F. Test

G. Answers to test

II. References:

A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, IL: Goodheart-Willcox, 1978.

B. *Copper Tube Handbook.* New York, NY: Copper Development, Assoc., 1973.

C. Watson, D.A. *Construction Materials and Processes.* New York, NY: McGraw-Hill, 1975.

PIPE
UNIT V

INFORMATION SHEET

I. Terms and definitions or descriptions

A. Galvanize--To coat metal, by hot dipping, with zinc in order to prevent rusting

B. P.V.C.--Rigid plastic pipe

(NOTE: This pipe is generally white. P.V.C. is the abbreviation for POLYVINYL CHLORIDE.)

C. Nipple--Short piece of pipe 12 inches or less in length

D. Nominal size--Name size of pipe rather than actual size

E. Flexible plastic pipe--Plastic pipe which comes in a roll and uses slip-in fittings with clamps

F. Tube--Fluid-carrying pipe which has a thin wall

G. Plumbing code--Laws and regulations which stipulate type, size, and quality of pipe material to use

II. Pipe used in residential plumbing work

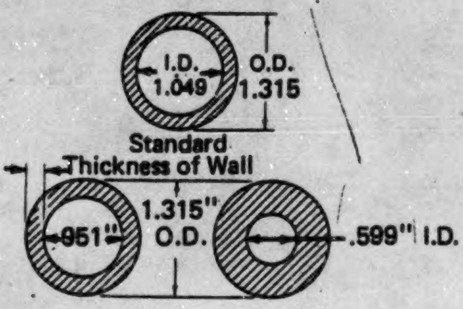
A. Steel (Transparency 1)

1. Black

2. Galvanized

(NOTE: Steel pipe comes in three different grades or strengths: standard, extra strong, and double extra strong. Standard weight is adequate for most plumbing installations. The outside diameter (O.D.) of the pipe remains the same regardless of the wall thickness (W.T). See Figure 1.)

Figure 1



B. Cast iron (Transparency 1)

1. Hub and Spigot

2. No-hub

(NOTE: Cast iron pipe is available in one grade, service (SV).)

C. Plastic (Transparency 2)

1. P.V.C. (Polyvinyl-chloride)

2. P.E. (Polyethylene)

(NOTE: Plastic pipe is available in four different strengths: schedule 40, schedule 80, pressure pipe, and pipe used for noncode applications. The selection of pressure pipe is based on the pressure of fluid which is to flow through the pipe. P.E. pipe is available in high density, which is used for gas piping and water service, and medium density, which is used for irrigation and sewers.)

D. Copper

1. DWV-Rigid

2. M-Rigid

3. L-Rigid

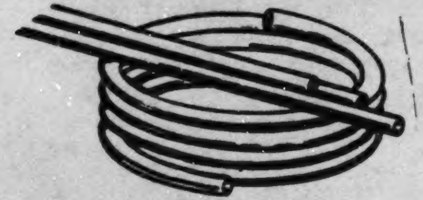
4. L-Soft

5. K-Rigid

6. K-soft

(NOTE: Rigid copper pipe is available in 20' lengths and soft copper pipe is available in 40', 60' and 100' coils. See Figure 2.)

FIGURE 2



E. Vitrified clay pipe (Transparency 3)

(NOTE: Vitrified clay pipe must be dense (concentrated) enough to withstand penetration and deterioration from acids and corrosive wastes. The vitrious (glass-like) surface is formed by mixing clay with salt and then firing (baking at high temperature). Usually the fitting and pipe are combined into one piece.)

INFORMATION SHEET

III. Identification colors of types of copper pipe

   A. DWV-Rigid--Yellow

   B. M-Rigid--Red

   C. L-Rigid--Blue

   D. L-Soft--Blue

   E. K-Rigid--Green

   F. K-Soft--Green

IV. Pipe applications in the plumbing trades

   (NOTE: Check local codes for pipe applications in your area.)

   A. Black steel pipe

      1. Natural gas lines

      2. Liquified petroleum gas lines

   B. Galvanized steel pipe

      1. Drain lines

      2. Vent lines

      3. Water lines

      (NOTE: Galvanized steel pipe is not to be used on gas lines.)

   C. Plastic pipe

      (NOTE: These applications apply to both flexible and P.V.C. pipe.)

      1. Water supply lines

      2. Underground gas lines

      3. Drain lines

      4. Vent lines

   D. Copper

      1. Water lines

      2. Drain lines

T-213-

3. Vent lines

4. Gas lines

(NOTE: Gas lines must be made with mechanical joints.)

E. Cast iron

1. Drain lines

2. Vent lines

F. Vitrified clay pipe

1. Sewer line

2. Storm drains

V. Differences between black steel and galvanized steel pipe

A. Black steel

1. Black steel pipe is varnished black to help prevent rust and distinguish it from galvanized pipe

2. It is limited to use with noncorrosive substances, such as gas, air, and steam

B. Galvanized steel pipe

1. Galvanized steel pipe is hot dipped to resist rusting

2. This pipe is used for applications with corrosive liquids such as water

(NOTE: Care should be taken with wrenches to avoid removing too much zinc coating.)

VI. Advantages and disadvantages of plastic pipe--PVC-DWV

A. Advantages

1. Lightweight

2. Resists corrosion and electrolysis

3. Easily installed

4. Comparatively inexpensive

INFORMATION SHEET

B. Disadvantages

(NOTE: Check manufacturer's specifications.)

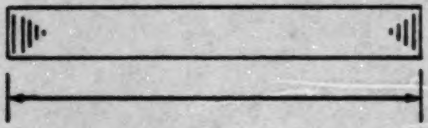
1. Will not stand temperatures over 150° F.
2. Not stable at pressures over 100 p.s.i.

VII. Methods of measuring pipe

A. End to end

1. Straight length of pipe
2. Measure pipe without fittings (Figure 1)

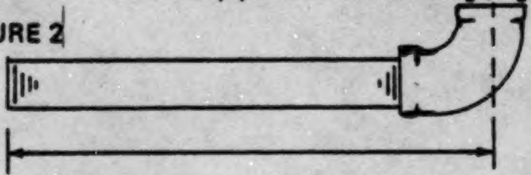
FIGURE I



B. End to center

1. Straight length of pipe
2. Tighten a fitting on one end
3. Measure from end of pipe to center of fitting (Figure 2)

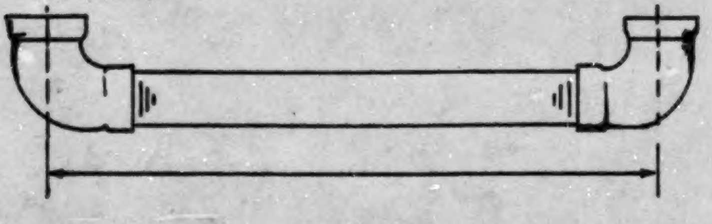
FIGURE 2



C. Center to center

1. Straight length of pipe
2. Tighten fitting on each end
3. Measure from center of one fitting to the center of the other (Figure 3)

FIGURE 3



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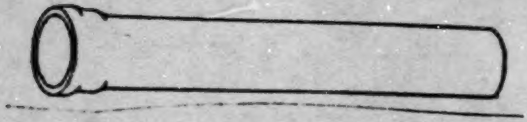
Steel And Cast Iron Pipe



Single Hub, 5' Lengths

Diams	2"	3"	4"	5"	6"	8"	10"	12"	15"
Sv Wts.	20	30	40	52	65	100	145	190	255
Xh. Wts.	25	45	60	75	95	150	215	270	375

Double Hub, 5' Lengths

Diams.	2"	3"	4"	5"	6"	8"	10"	12"	15"
Sv. Wts.	21	31	42	54	68	105	150	200	270
Xh Wts.	26	47	63	78	100	157	225	285	395

Single Hub, 10'

Diams	Sv. Wts.	Xh. Wts.
2"	38	43
3"	56	83
4"	75	108
5"	98	133
6"	124	160
8"	185	265
10"	270	400
12"	355	480
15"	475	705

No-Hub

Double Hub, 30" Lengths
(25" Laying Lengths)

Diam.	Sv. Wts.	Wts.
2"	11	14
3"	17	26
4"	23	33

Types of Pipe
(Continued)

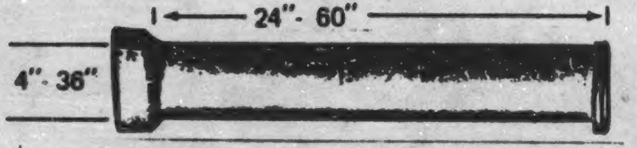
TYPE	GRADE	DIAMETER RANGE (IN INCHES)	TYPICAL APPLICATION
ABS	DWV	1 1/4 — 6	DRAINAGE WASTE AND VENTING IN RESIDENTIAL CONSTRUCTION
	SERVICE	1 1/4 — 6	NONCODE APPLICATIONS
PVC	DWV	1 1/4 — 6	DRAINAGE, WASTE AND VENTING IN RESIDENTIAL CONSTRUCTION
	THIN WALL	1 1/2 — 4	DRAINAGE, WASTE AND VENTING NOT ENCLOSED WITHIN WALLS (NOT ALLOWED BY SOME CODES)
	PRESSURE PIPE	1/2 — 6	SELECTION BASED ON PRESSURE OF FLUID WHICH IS TO FLOW THROUGH PIPE
CPVC		1/2 — 3/4	HOT WATER LINES
PE	HIGH DENSITY	1/4 — 12	GAS PIPING
	MEDIUM DENSITY	1/4 — 48	IRRIGATION, SEWER MAINS
SR		1/2 — 12	STORM DRAINS, SEPTIC TANK AND LEACH FIELDS

Types of Plastic Pipe: Grade, Size, and Application

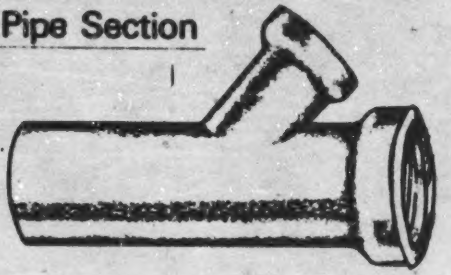
Types Of Pipe

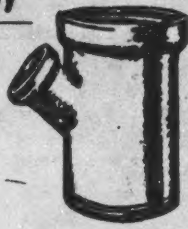
(Continued)

Vitrified Clay

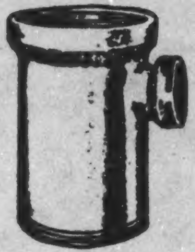


Pipe Section

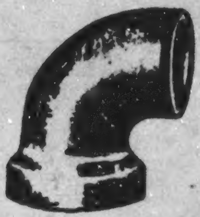




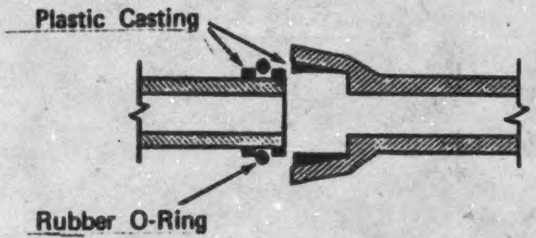
Wye

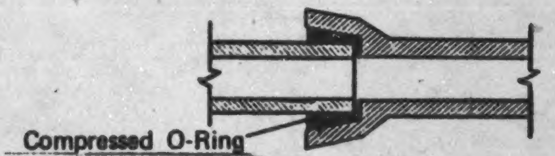


Tee

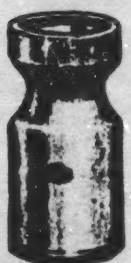


Elbow

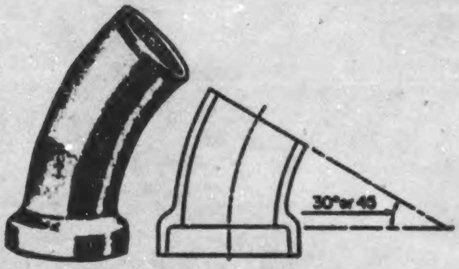

Plastic Casting
Rubber O-Ring


Compressed O-Ring

Compression joint in vitrified clay pipe assembles rapidly and needs no additional "set up" time.



Bushing



Elbow(30%–45%)

PIPE
UNIT V

ASSIGNMENT SHEET #1--CONSTRUCT A MATERIALS TAKE-OFF LIST FROM AN ISOMETRIC DRAWING

Directions: Using the piping system that is shown in Figure 1, construct a materials take-off list.

	MATERIALS	TOTAL NUMBER
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		

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ASSIGNMENT SHEET #1

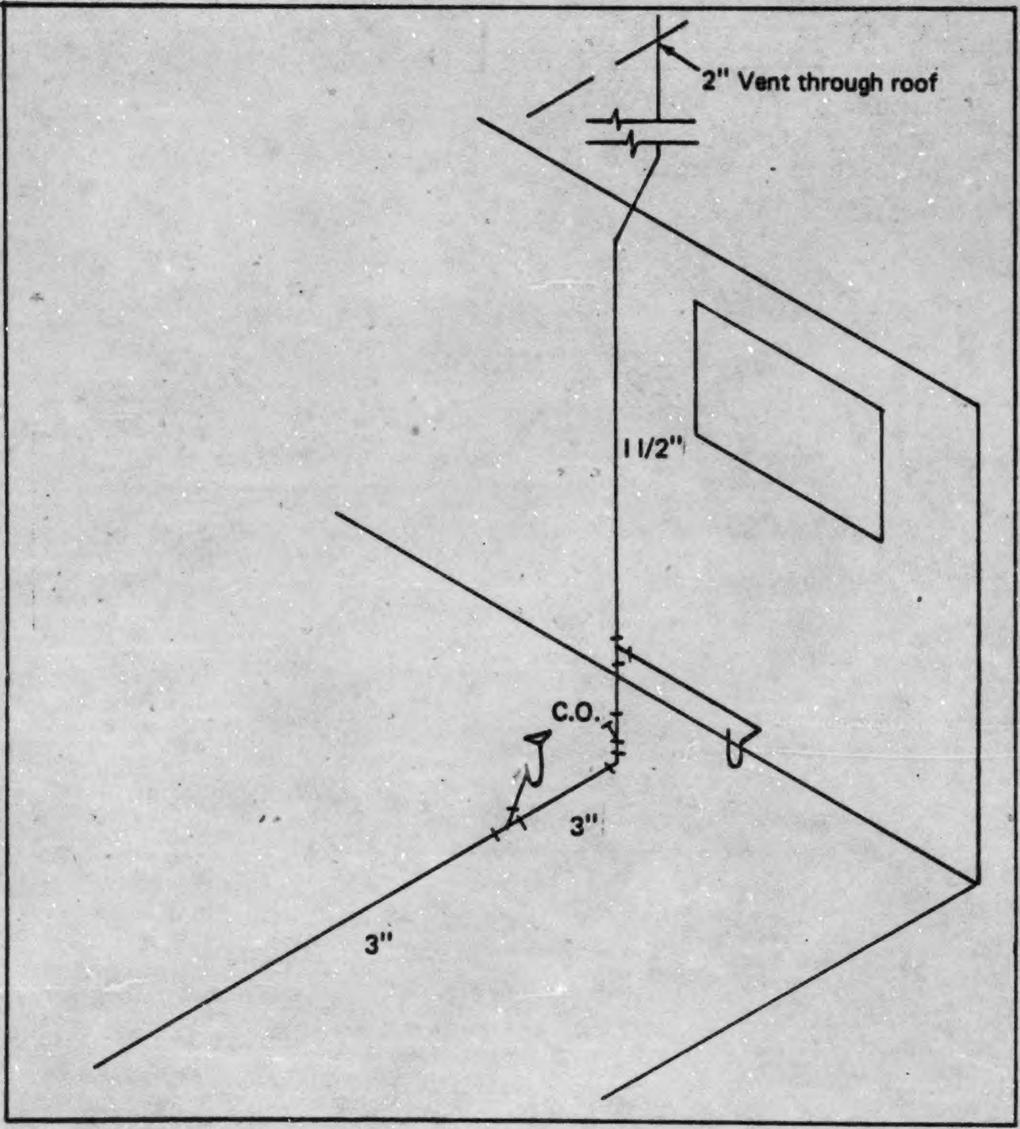
2" Vent through roof
1 1/2"
C.O.
3"
3"

FIGURE 1

2'14-D

ASSIGNMENT SHEET #2–SECURE A PERMIT FOR THE INSTALLATION OF A PLUMBING SYSTEM

EVALUATION: Given a plumber's license number, information concerning location where work is to be done, and a knowledge of codes, make application for and secure a plumbing installation permit from a municipal or district permit office. All information supplied should be accurate and be verified by your instructor.

I. Tools and equipment

- A. License number
- B. Information concerning plumbing installation
- C. Application for permit
- D. Code book
- E. Pencil

II. Procedure

- A. Study the information concerning a plumbing installation
- B. Draw appropriate sketches
- C. Check with instructor for proper procedures for submitting application
- D. Secure permit
- E. Ask instructor for evaluation of work

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PIPE
UNIT V

ANSWERS TO ASSIGNMENT SHEET #1

MATERIALS	TOTAL NUMBER
1. 3" x 5' cast iron double hub pipe	1
2. 3" x 5' cast iron single hub pipe	2
3. 3" C.I. Y	2
4. #" C.I. long turn ell	2
5. 3" clean-out	1
6. 3" C.I. P trap	1
7. 3" C.I. floor drain	1
8. 3" x 1 1/2" C.I. TY	1
9. 3" x 1 1/2" C.I. reducing bushing	1
10. 21' x 1 1/2" galvanized steel pipe	1
11. 1 1/2" galvanized steel 90° Ell	1
12. 1 1/2" galvanized steel nipple	2
13. 1 1/2" galvanized steel P trap	1
14. 1 1/2" galvanized steel 45° Ell	2
15. 1 1/2" x 2" coupling	1
16. 3' x 2" galvanized pipe	1
17. 2" roof flashing	1

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PIPE
UNIT V

NAME______________________________

TEST

1. Match the terms on the right to the correct definitions.

______ a. Rigid plastic pipe

______ b. Name size of pipe rather than actual size

______ c. Plastic pipe which comes in a roll and uses slip-in fittings with clamps

______ d. Laws and regulations which stipulate type, size, and quality of pipe material to use

______ e. Short piece of pipe 12 inches or less in length

______ f. Fluid-carrying pipe which has a thin wall

______ g. To coat metal, by hot dipping, with zinc in order to prevent rusting

1. Tube
2. Galvanize
3. Plumbing code
4. Nominal size
5. P.V.C.
6. Nipple
7. Flexible plastic pipe

2. Select six types of pipes used in residential plumbing by placing an "X" in the appropriate blanks.

______ a. Black steel

______ b. Galvanized steel

______ c. Cast iron

______ d. Brick

______ e. PDT plastic

______ f. P.E.

______ g. Ivory

______ h. Copper

______ i. Wood

______ j. Vitrified clay

3. Match the types of copper pipe on the right to the correct identification colors.

(NOTE: Some colors identify two types of copper pipe.)

______ a. Yellow

______ b. Red

______ c. Blue

______ d. Green

1. L-soft
2. K-soft
3. DWV-Rigid
4. K-Rigid
5. M-Rigid
6. L-Rigid

4. List one application for each type of pipe to be used in the plumbing trade.

    a. Black steel–

    b. Galvanized steel–

    c. Plastic pipe–

    d. Copper–

    e. Cast iron--

    f. Vitrified clay–

5. Discuss the differences between black steel and galvanized steel pipe.

    a. Black steel

        1.

        2.

    B. Galvanized steel

        1.

        2.

6. List four advantages and two disadvantages of plastic pipe.

    a. Advantages

        1.

        2.

        3.

        4.

    B. Disadvantages

        1.

        2.

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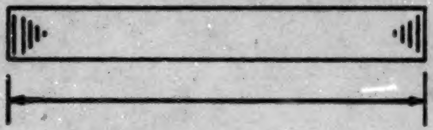
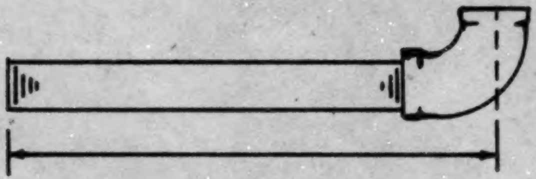
7. Discuss the three common methods of measuring pipe using the illustrations below.

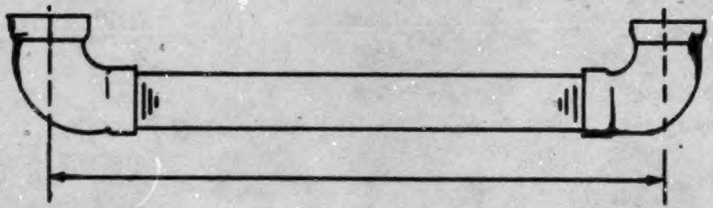
a.



b.



c.



8. Construct a materials take-off list from an isometric drawing.

9. Secure a permit for an installation of a plumbing system.

ANSWERS TO TEST

1. a. 5
   b. 4
   c. 7
   d. 3
   e. 6
   f. 1
   g. 2
2. a, b, c, f, h, j
3. a. 3
   b. 5
   c. 1, 6
   d. 2, 4
4. Any one under each type of pipe:
   a. Black steel pipe
      1) Natural gas lines
      2) Liquified petroleum gas lines
   b. Galvanized steel pipe
      1) Drain lines
      2) Vent lines
      3) Water lines
   c. Plastic pipe
      1) Water supply lines
      2) Underground gas lines
      3) Drain lines
      4) Vent lines

d. Copper
  1) Water lines
  2) Drain lines
  3) Vent lines
  4) Gas lines

e. Cast iron
  1) Drain lines
  2) Vent lines

f. Vitrified clay
  1) Sewer lines
  2) Storm drains

5. Discussion should include:

a. Black steel
  1) Black steel pipe is varnished black to help prevent rust and distinguish it from galvanized pipe
  2) It is limited to use with noncorrosive substances such as gas, air, and steam

b. Galvanized pipe
  1) Galvanized steel pipe is hot dipped to resist rusting
  2) This pipe is used for applications with corrosive liquids such as water

6. a. Advantages
  1) Lightweight
  2) Resists corrosion and electrolysis
  3) Easily installed
  4) Comparatively inexpensive

b. Disadvantages
  1) Will not stand temperatures over 150° F
  2) Not stable at pressures over 100 p.s.i.

7. a. End to end
    1) Straight length of pipe
    2) Measure pipe without fittings
   b. End to center
    1) Straight length of pipe
    2) Tighten a fitting on one end
    3) Measure from end of pipe to center of fitting
   c. Center to center
    1) Straight length of pipe
    2) Tighten fitting on each end
    3) Measure from center of one fitting to the center of the other

8. Evaluated to the satisfaction of the instructor

9. Evaluated to the satisfaction of the instructor

P-285-D

PRIVATE WATER SYSTEMS
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify types of private water supplies and pump controls used on private water supplies. The student should also be able to describe the operating principles of three types of pumps and install a pump and controls according to manufacturer's specifications. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with private water systems to the correct definitions or descriptions.
2. Identify types of private water supplies.
3. Select true statements describing various private water supplies.
4. List possible sources of contamination in private water supplies.
5. Identify various pump controls used on private water systems.
6. Select true statements concerning the applications of various controls on private water systems.
7. Identify types of pumps used for private water systems.
8. Describe the operating principles of three types of pumps.
9. Compute the cost for plumbing supplies.
10. Demonstrate the ability to install a pump and controls according to manufacturer's specifications.

PRIVATE WATER SYSTEMS
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide student with objective sheet.
- B. Provide student with information, assignment, and job sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information and assignment sheets.
- F. Demonstrate and discuss the procedures outlined in the job sheet.
- G. If possible, visit a well drilling company and see a project in operation.
- H. Have manufacturer's representative visit class.
- I. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete assignment and job sheets.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
  1. TM 1--Private Water Supplies
  2. TM 2--Private Water Supplies (Continued)
  3. TM 3--Springs
  4. TM 4--Contamination of Water Supplies

I-3-E

        5. TM 5--Pump Controls

        6. TM 6--Pump Controls (Continued)

        7. TM 7--Types of Pumps

        8. TM 8--Types of Pumps (Continued)

        9. TM 9--Operation of a Piston Pump

        10. TM 10--Operation of a Centrifugal Pump

        11. TM 11--Operation of a Jet Pump

    D. Assignment Sheet #1--Compute the Costs for Plumbing Supplies

    E. Job Sheet #1--Install a Pump and Controls According to Manufacturer's Specifications

    F. Test

    G. Answers to test

II. Reference--Henderson, G. E. *Planning for an Individual Water System.* Athens, GA: American Association for Vocational Instructional Materials, 1973.

4-E

PRIVATE WATER SYSTEMS
UNIT I

INFORMATION SHEET

I. Terms and definitions or descriptions

A. Potable water--Water that is free from impurities which cause disease or harmful effects

(NOTE: The water shall conform to public health department standards.)

B. Pump--A device which uses mechanical power to move or lift liquid from one point to another

C. Relief valve--A safety device installed in a water system to automatically reduce excess pressure

D. Foot valve--A device placed at the lower end of the suction pipe in order to keep the pipe full of water

E. Check valve--A valve which allows water to flow in only one direction

F. Suction line--Pipe which carries water from its source, such as a well or spring box, to the pump

G. Discharge line--That pipe which carries water from the pump to the pressure tank or water system

H. Pressure tank--A device which receives the discharge from the pump and develops pressure by compressing air

I. Gate valve--A water controller which is used to isolate parts of the pumping system

J. Water table--The height to which underground water will be found in a specific location

(NOTE: This will vary according to consumption rate and weather conditions.)

K. P.S.I.--Pounds per square inch, the measurement of pressure in water systems

L. Impervious layer--Sub-soil section, usually containing clay or rock, which resists or prevents flow or absorption of water

M. Centrifugal--Operating in a circular motion

N. Reciprocating--Operating in a back-and-forth motion

(NOTE: A reciprocating pump operates much like the pistons in an automobile.)

INFORMATION SHEET

II. Various types of private water supplies (Transparencies 1, 2, 3)

A. Dug well

B. Bored well

C. Protected spring

D. Washed or jetted driven well

E. Drilled well

F. Storage tanks

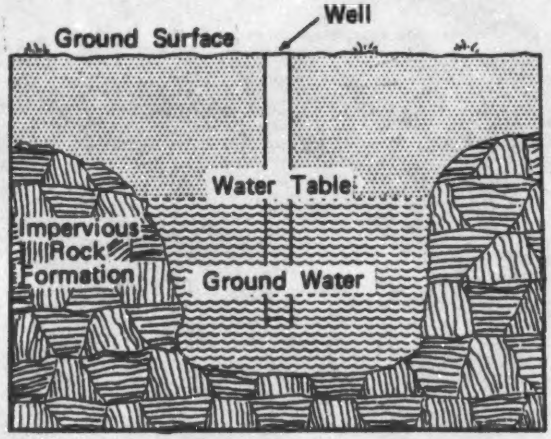
(NOTE: Storage tank are sometimes referred to as cisterns.)

G. Pond or lake

III. Descriptions of private water supplies (Transparencies 1,2, and 3)

A. A dug well consists of a hole in the ground 3 to 20 feet in diameter and deep enough to extend below the ground water table (Figure 1)

FIGURE 1



B. A bored well is made with an auger, either hand or power operated

C. A spring is water that rises to the surface from some underground source

(NOTE: Springs are very seldom found where the general lay of the land is flat.)

INFORMATION SHEET

D. A driven well consists of a pipe with a device on the lower end which is screened to allow ground water to enter the pipe

   1. Driven wells can become less productive if screens become clogged with sand

   2. It is possible to connect two or more driven wells to increase water supply

   3. A "washed" or "jetted" driven well saves manpower, but requires a pumping apparatus

E. A drilled well consists of a steel pipe, 4 to 6 inches in diameter, used as a casing to protect the hole from cave-ins and other disturbances

   1. In loose soils, the casing is extended all the way to the water bearing area

   2. In impervious soils, the casing is extended through the surface soil to the impervious layer

   3. Drilling can be done by percussion (punching and hammering) and rotary (biting and drilling)

F. Storage tanks provide water collected from rain or sub-surface ground

G. Ponds or lakes can be a source of potable water if proper treatment is applied

IV. Sources of contamination in private water supplies (Transparency 4)

A. Leaking sewer lines

B. Houses treated for termite control

C. Septic tanks

D. Leach (absorption) fields

E. Barnyards

F. Flooded land

G. Unsealed wells

(NOTE: Unsealed wells are susceptable to contamination from debris, animals, and vermin.)

V. Pump controls used on private water systems (Transparencies 5, 6)

  A. Switch box

  B. Pressure switch

  C. Float switch

  D. Air volume control

  E. Floating air seal

  F. Precharged tank

  G. Sealed-in air chamber

  H. Pressure relief valve

  I. Pressure gauge

  J. Foot valve

  K. Spring loaded check valve

  L. Gate valves

VI. Pump controls applications

  A. Electrical control box

    1. Pump must be fused separately

    2. Master control should be positioned near pump room entrance in a high, dry location

    3. Local control switch should be placed near the pump for manual off-on operation

    4. All electrical wiring must be done according to approved methods, materials, and workmanship

    (CAUTION: In most cases, a licensed electrician should do the wiring.)

INFORMATION SHEET

B. Pressure switch

1. Controls pump operation to determine necessary pressure

2. Most pressure switches are factory set at 20-40 lbs. pressure

   (NOTE: This means that the switch closes when the pressure drops to 20 lbs. and opens when the pressure builds up to 40 lbs. In some instances, the pressure switch must be adjusted at time of installation.)

4. The "differential," the difference between "on" and "off" pressures, is usually 20 lbs.

5. A reliable pressure gauge should accompany a pressure switch installation

6. A small socket wrench is a suitable tool for adjusting a pressure switch

C. Float switch

1. Controls pump operation to fill gravity storage tank

2. Float switch operates by float rather than pressure control

   (NOTE: The float switch operates on the same principle as the water closet control valve.)

D. Air volume control

1. Controls amount of air in pressure tank systems

2. Air in tank is compressed when water is forced into it by the pump

   (NOTE: Water cannot be compressed to any measurable amount.)

3. When pump stops, compressed air keeps pressure on the water

4. The compressed air pushes the water into the water distribution system

5. Air in the tank is gradually absorbed by the water until very little air space is left

   (NOTE: Time varies according to tank size.)

6. The pump will start and stop more frequently due to less air volume

   (NOTE: This is referred to as a water-logged tank.)

7. An air-volume control replaces the air which has been absorbed by the water

E. Floating air seals help to lower the air absorption rate in pressure tanks

F. Precharging a pressure tank increases the amount of water available between pump stops and starts

G. Sealed-air chambers keep the air from being absorbed into the water

H. Pressure relief valves are installed on reciprocating (piston) pumps to relieve excess pressure

I. Pressure gauges indicate storage tank pressures

(NOTE: Pressure gauges are necessary to adjust pressure switches.)

J. Valves control the flow of water throughout a pumping installation

1. Foot valves keep the suction pipe filled with water

2. Check valves keep the storage tank supply from emptying when pump is being repaired

(NOTE: Check valves should be installed between pump and tank.)

3. Gate valves should be used in pump installations to assure maximum flow of water

VII. Types of pumps (Transparencies 7 and 8)

A. Piston

(NOTE: Piston pumps can be either double acting or single acting, and either shallow or deep well pumps.)

B. Centrifugal

(NOTE: Centrifugal pumps can be either shallow or deep well pumps.)

C. Jet

(NOTE: Jet pumps can be either shallow or deep well pumps.)

INFORMATION SHEET

VIII. Operating principles of pumps

A. Piston pumps (Transparency 9)

1. Single acting piston

   a. Suction stroke draws water into the cylinder

   b. Discharge stroke pushes water into the discharge pipe

2. Double acting piston

   a. Movement of the plunger to the right pulls water from well into the left chamber

   b. Water is forced out of the right chamber

   c. Plunger movement to the left forces water out of left chamber

   d. Water is pulled from well into the right chamber

   (NOTE: The double acting piston provides a constant flow, while the single acting piston provides spurts of water. Piston pumps are "positive-acting", that is, the discharge is the exact amount drawn into the cylinder.)

B. Centrifugal pumps (Transparency 10)

1. An L-shaped pipe, completely filled with water and rotated rapidly will pump water out of a bucket

   (NOTE: If the suction pipe and lateral arm are filled with water and then rotated, water in the lateral arm is thrown out by centrifugal force.)

2. By adding more lateral arms, more water is pumped

3. With a manufactured pump, the lateral arms are replaced with an impeller

   (NOTE: Centrifugal pumps are not "positive-acting". Their pumping action slips if too much discharge resistance is encountered.)

4. For higher pressures or greater lifts, two or more impellers are used

   (NOTE: In this multi-stage pump, pressure is increased as the water goes from one impeller to the next.)

P-11-E

INFORMATION SHEET

C. Jet pumps (Transparency 11)

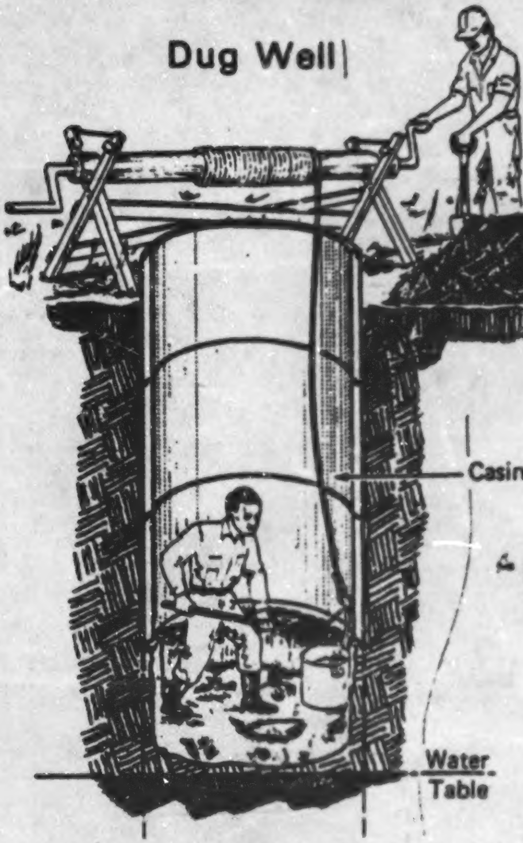
1. Water is supplied to the jet nozzle under pressure

2. Water surrounding the jet stream is lifted and carried through the pipe as a result of the jet action

   (NOTE: Deep well centrifugal pumps need the use of an ejector to pump water more than 25 feet in height. Shallow wall pumps have improved efficiency if an ejector (jet) is installed. When a jet is used with a centrifugal pump, a portion of the water delivered by the pump is returned to the jet nozzle to operate it. The jet lifts water from the well to a level where the centrifugal pump can finish lifting it by suction.)

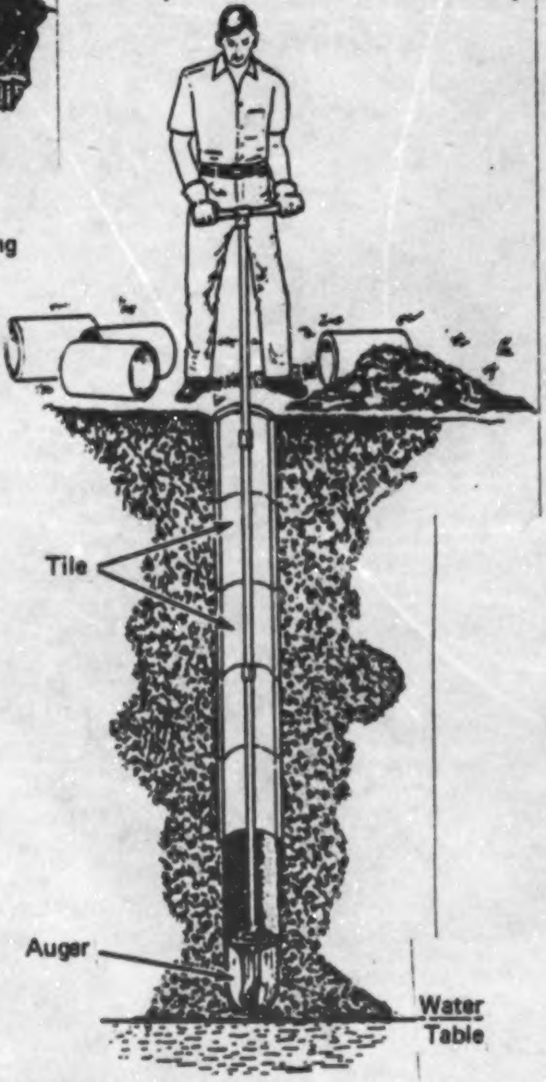
Private Water Supplies

Dug Well


Casing
Water Table

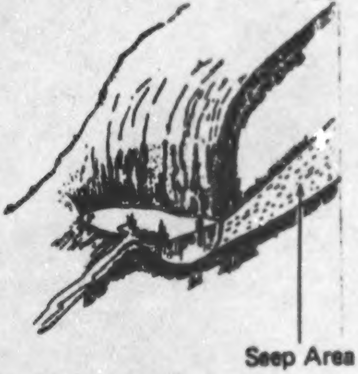
A dug well consists of a hole 3 to 20 feet in diameter and deep enough to extend below the ground water table.

Bored Well


Tile
Auger
Water Table

A bored well is usually 8 to 14 inches in diameter and extended below the water table.

Protected Spring

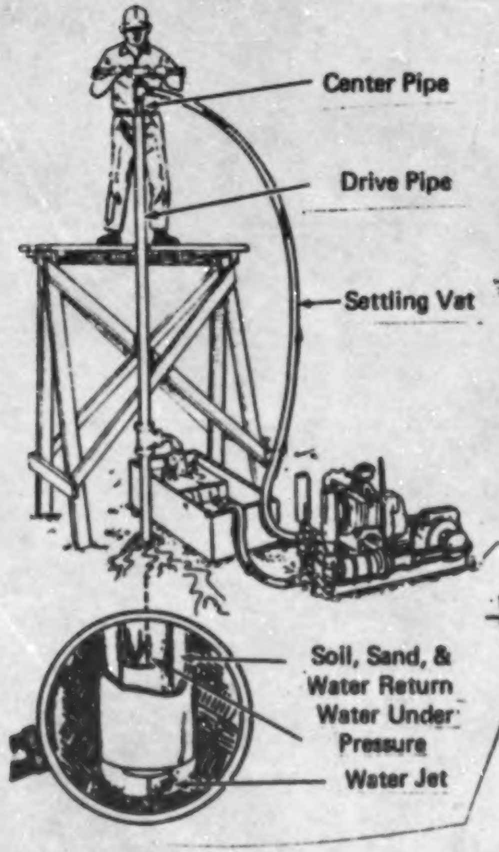


Springs supply water from underground sources.

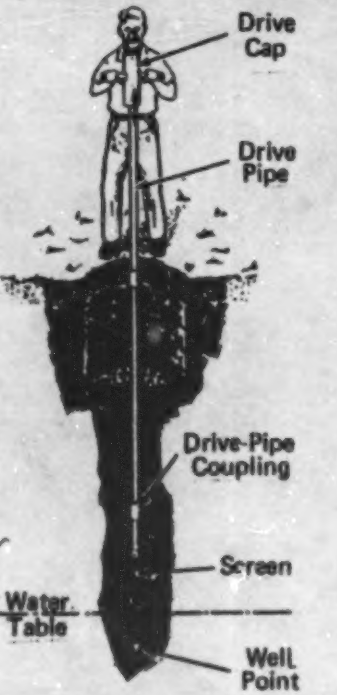
Private Water Supplies

(Continued)

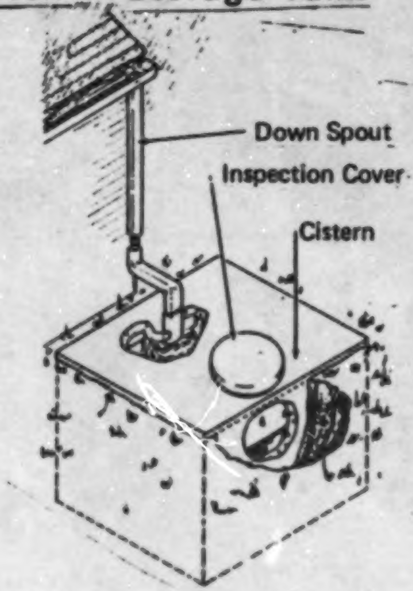
Drilled Well


Center Pipe
Drive Pipe
Settling Vat
Soil, Sand, & Water Return
Water Under Pressure
Water Jet

Washed or Jetted Well

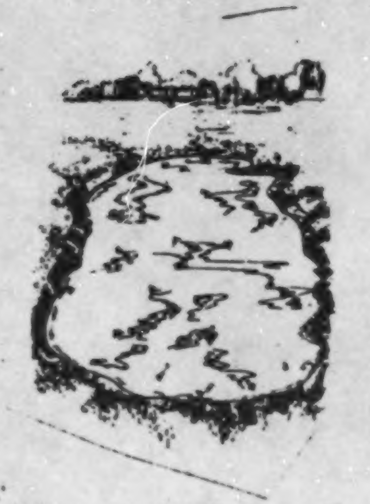

Drive Cap
Drive Pipe
Drive-Pipe Coupling
Screen
Water Table
Well Point

Storage Tank


Down Spout
Inspection Cover
Cistern

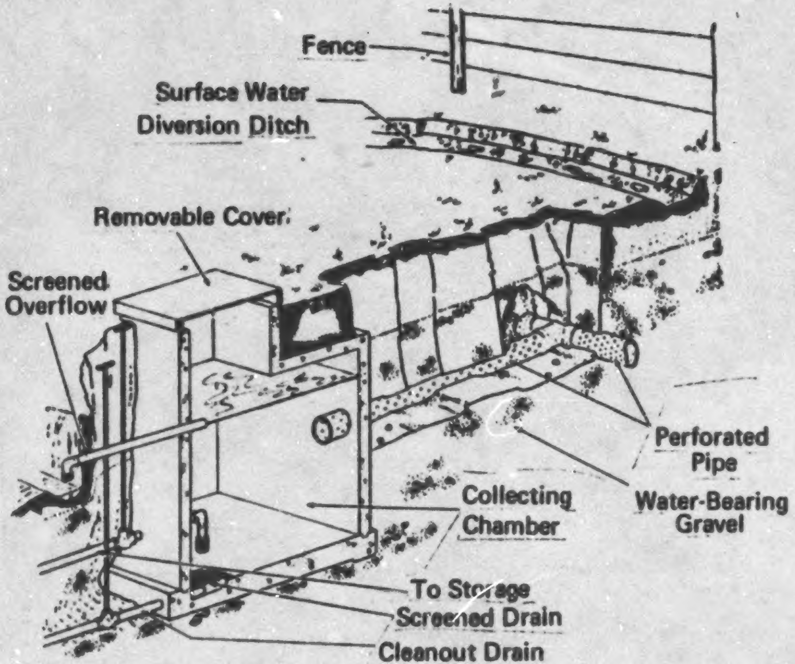
Storage tanks are used to collect rainwater from rooftops

Ponds



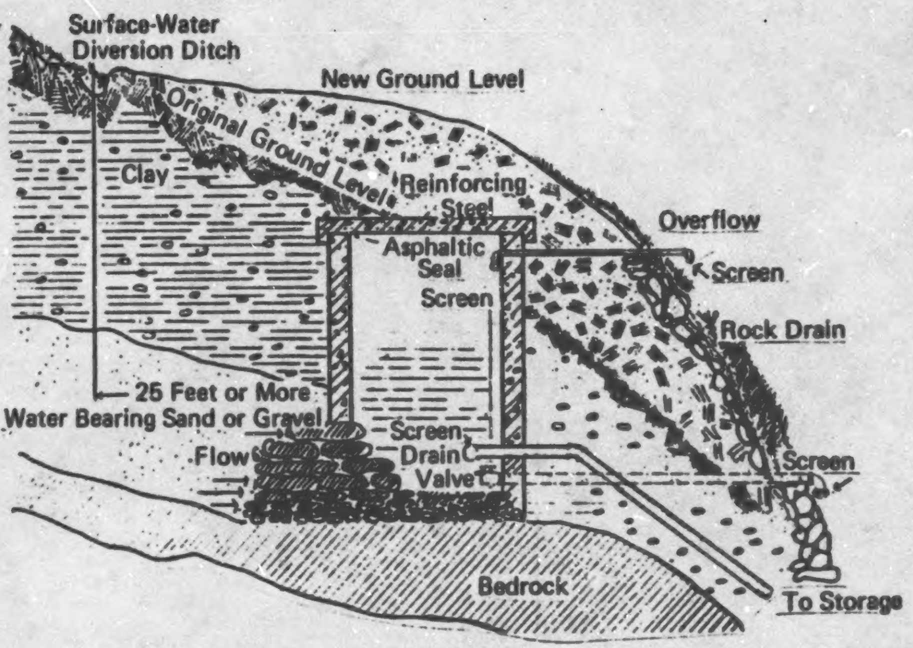
Lakes or ponds collect run-off water from surrounding slopes

Springs


Fence
Surface Water Diversion Ditch
Removable Cover
Screened Overflow
Perforated Pipe
Water-Bearing Gravel
Collecting Chamber
To Storage
Screened Drain
Cleanout Drain

A design for collecting water from a spring that provides protection against surface pollution and provides a means for entering and cleaning the collecting chamber

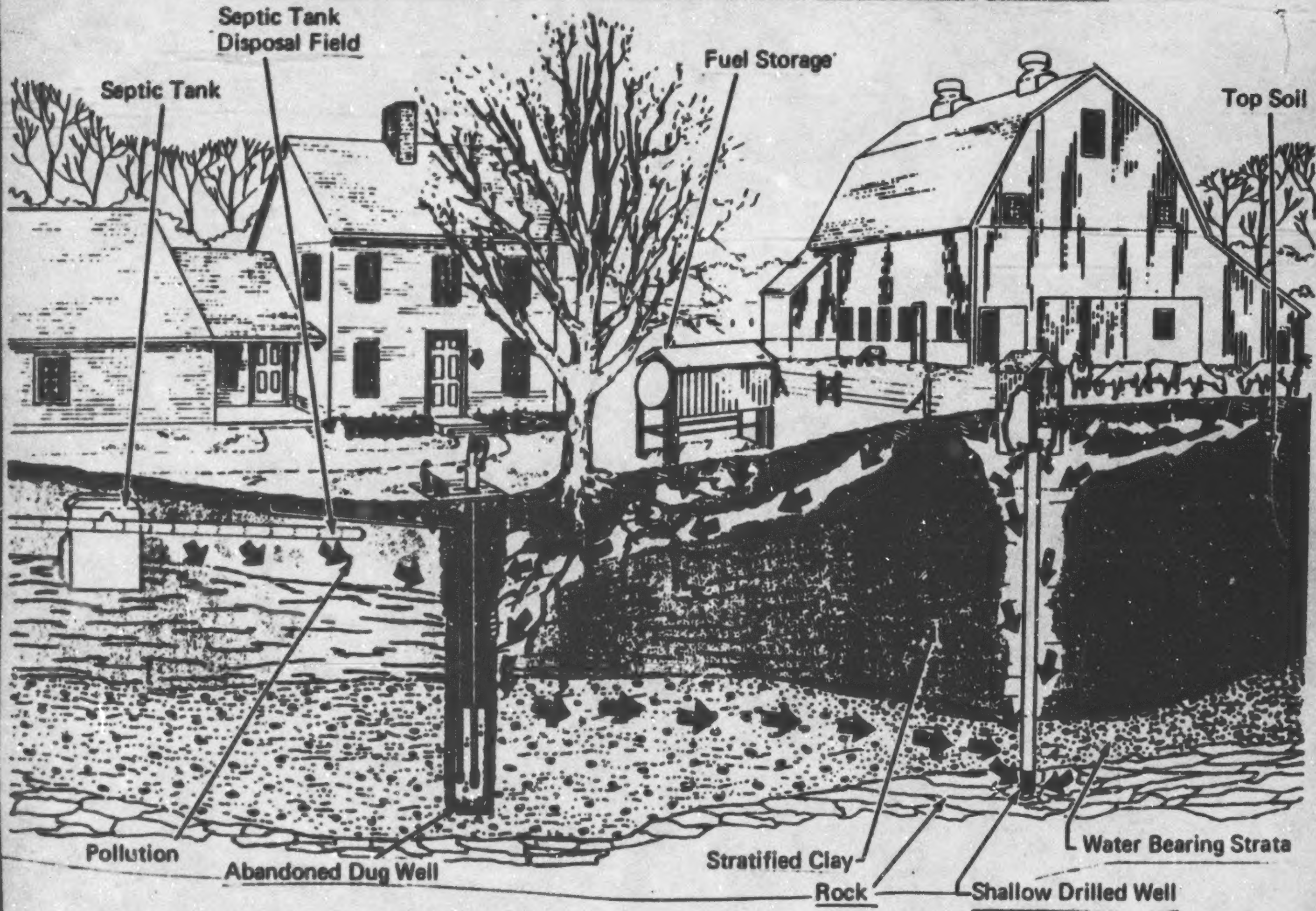
751


Surface-Water Diversion Ditch
New Ground Level
Original Ground Level
Clay
Reinforcing Steel
Asphaltic Seal
Screen
Overflow
Screen
Rock Drain
25 Feet or More
Water Bearing Sand or Gravel
Flow
Screen
Drain
Valve
Screen
Bedrock
To Storage

Protection of Spring from Surface Contamination

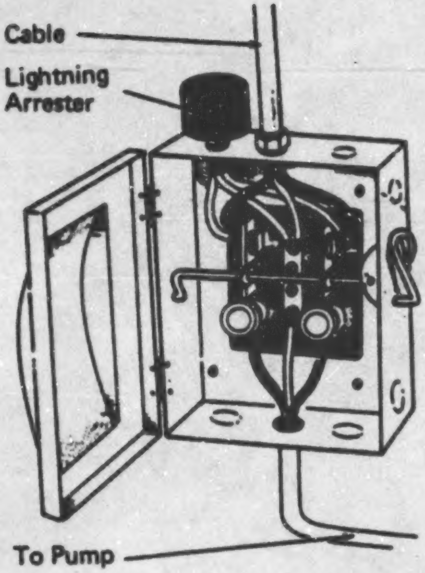
752

Contamination of Water Supplies

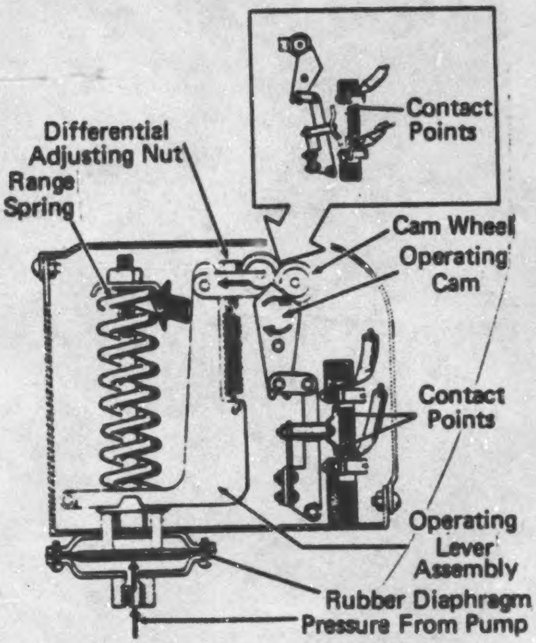

Septic Tank Disposal Field
Septic Tank
Fuel Storage
Top Soil
Pollution
Abandoned Dug Well
Stratified Clay
Rock
Shallow Drilled Well
Water Bearing Strata

Shallow wells can become polluted more readily than deep wells. Note that pollution can come from underground sources as well as from surface sources.

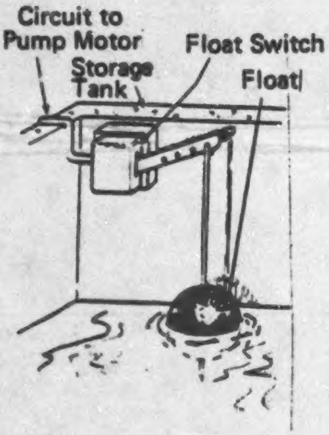
Pump Controls


Cable
Lightning Arrester
To Pump

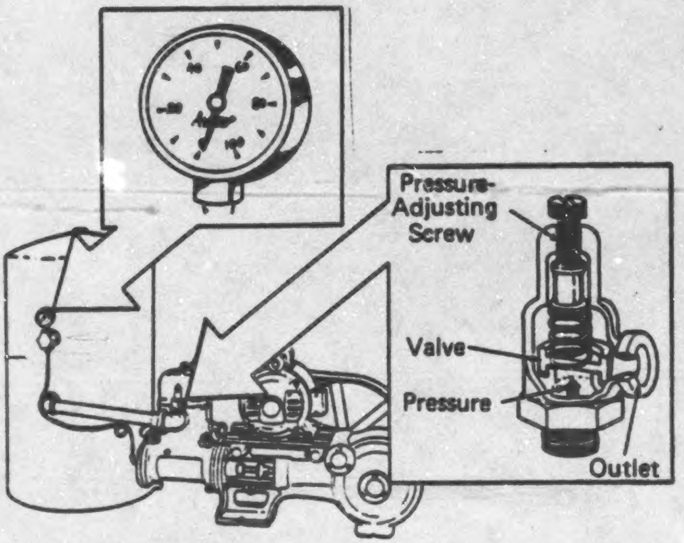
Switch Box


Contact Points
Differential Adjusting Nut
Range Spring
Cam Wheel
Operating Cam
Contact Points
Operating Lever Assembly
Rubber Diaphragm
Pressure From Pump

Pressure Switch


Circuit to Pump Motor
Storage Tank
Float Switch
Float

Float Switch

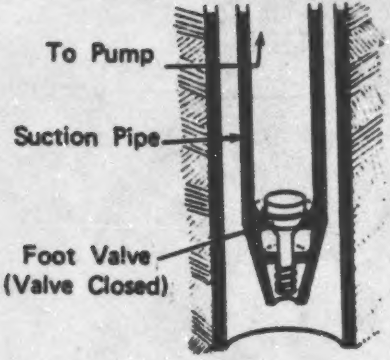

Pressure-Adjusting Screw
Valve
Pressure
Outlet

Pressure Gauge

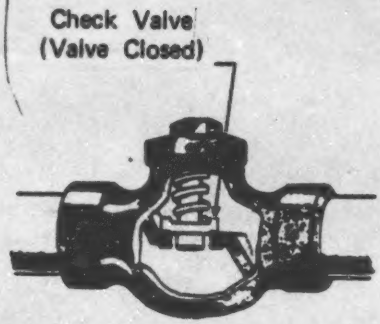
Pressure Relief Valve

Pump Controls

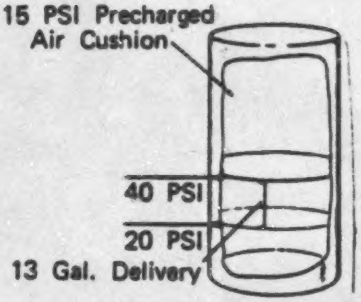
(Continued)


To Pump
Suction Pipe
Foot Valve
(Valve Closed)

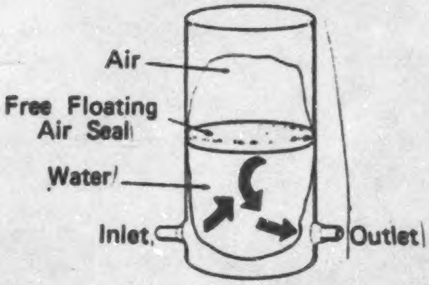
Foot Valve


Check Valve
(Valve Closed)

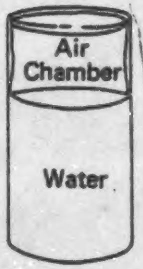
Spring Loaded Check Valve


15 PSI Precharged
Air Cushion
40 PSI
20 PSI
13 Gal. Delivery

Precharged Tank

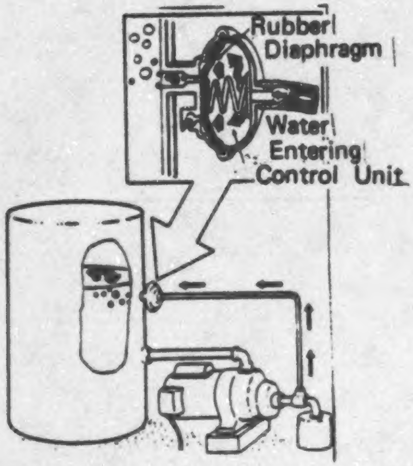

Air
Free Floating
Air Seal
Water
Inlet
Outlet

Floating Air Seal

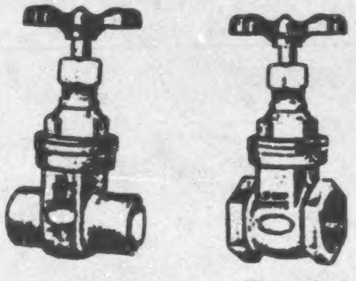

Air
Chamber
Water

Sealed-in Air Chamber

A Float that rides up and down with the water level effectively seals off the air from the water and keeps air absorption to a minimum.

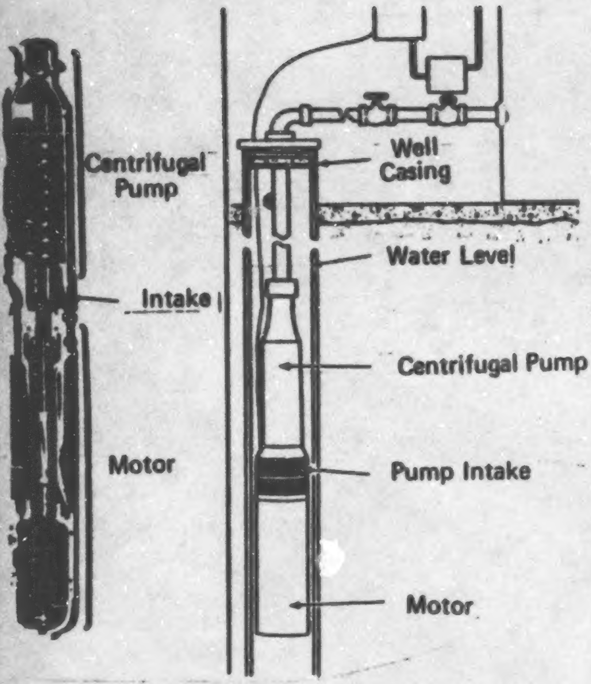

Rubber
Diaphragm
Water
Entering
Control Unit

Air Volume Control


Soldered Threaded

Gate Valves

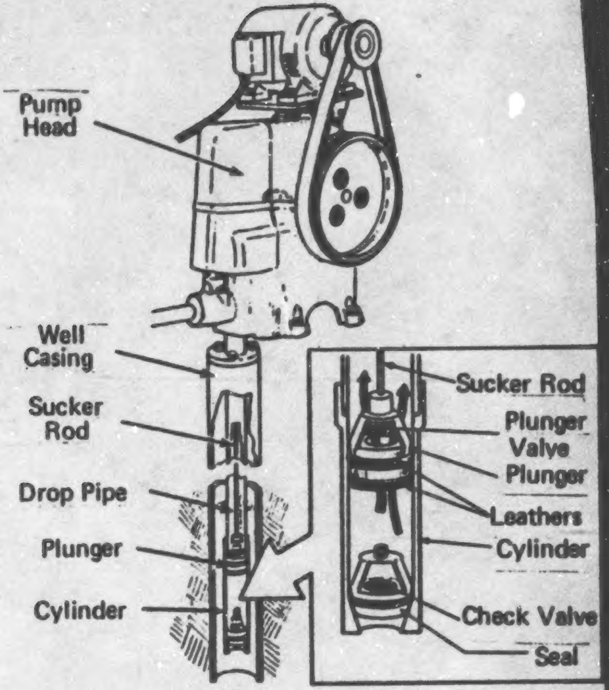
Types of Pumps


Centrifugal Pump
Intake
Motor
Well Casing
Water Level
Centrifugal Pump
Pump Intake
Motor

Centrifugal Pump

(Deep Well Submersible)

(NOTE: Pump and motor is installed in the well, below the water level)


Pump Head
Well Casing
Sucker Rod
Drop Pipe
Plunger
Cylinder
Sucker Rod
Plunger Valve
Plunger
Leathers
Cylinder
Check Valve
Seal

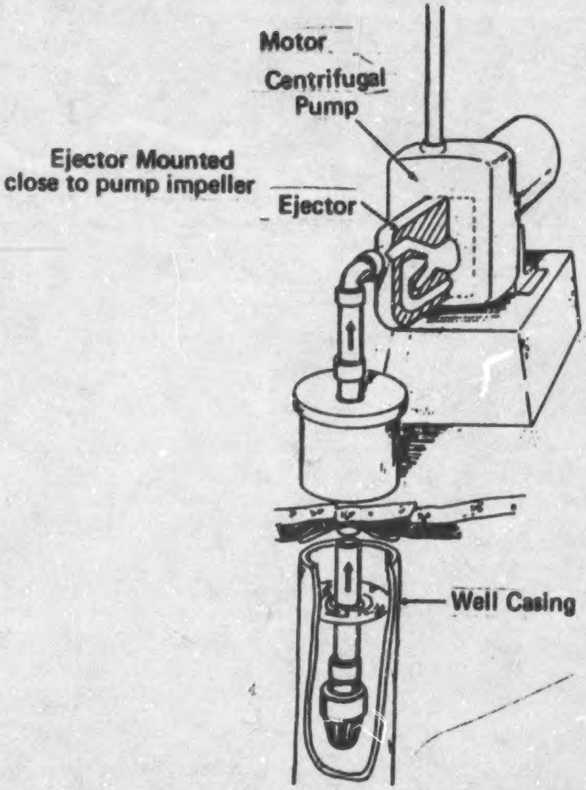
Piston Pump

(Deep Well)

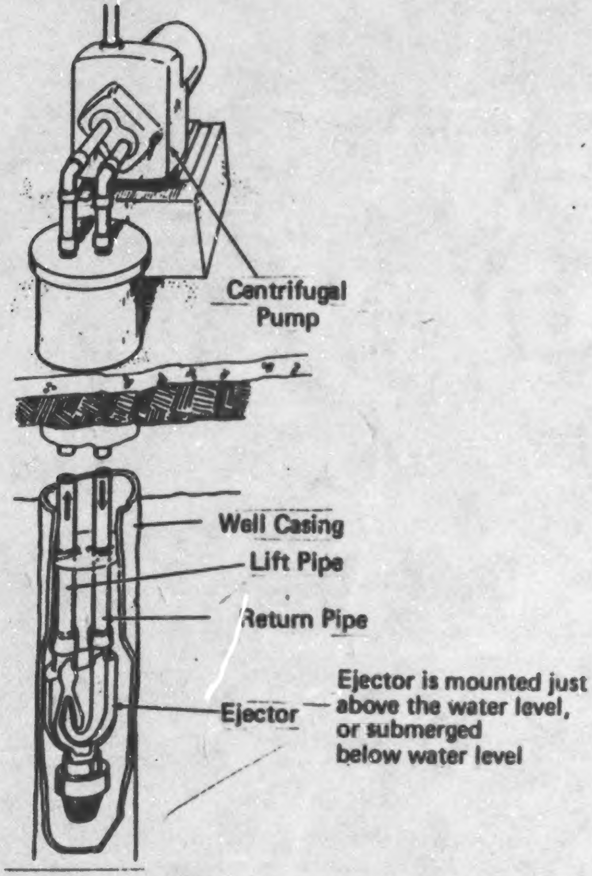
(NOTE: Pumping mechanism is in the well, usually below water level.)

Types of Pumps

(Continued)


Motor
Centrifugal Pump
Ejector Mounted close to pump impeller
Ejector
Well Casing

Shallow Well Jet Pump

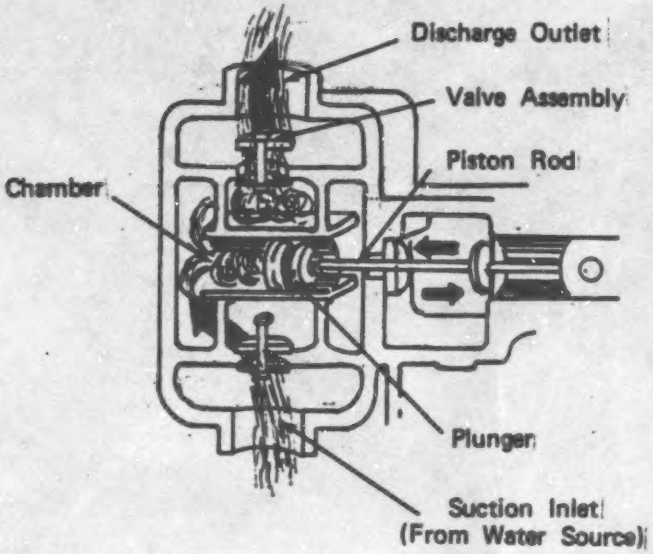

Centrifugal Pump
Well Casing
Lift Pipe
Return Pipe
Ejector
Ejector is mounted just above the water level, or submerged below water level

Deep Well Jet Pump

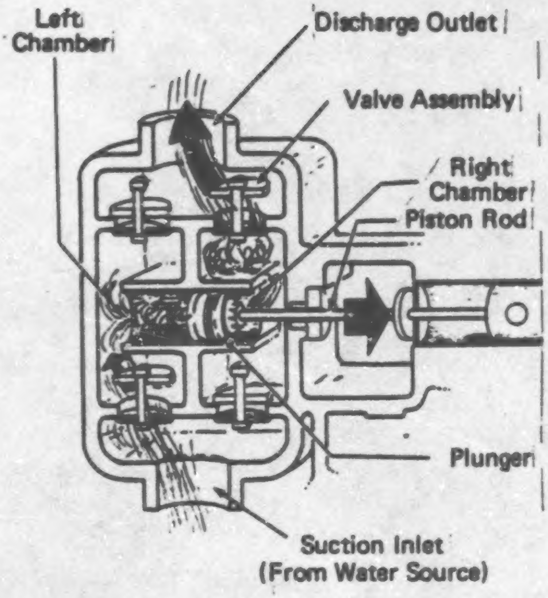
(NOTE: The ejector is in a venturi fitting.)

Operation of a Piston Pump

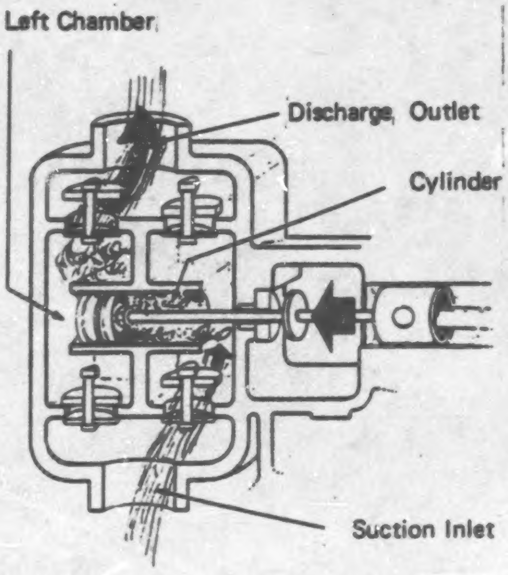
Single Acting Piston


Discharge Outlet
Valve Assembly
Piston Rod
Chamber
Plunger
Suction Inlet
(From Water Source)

Double Acting Piston

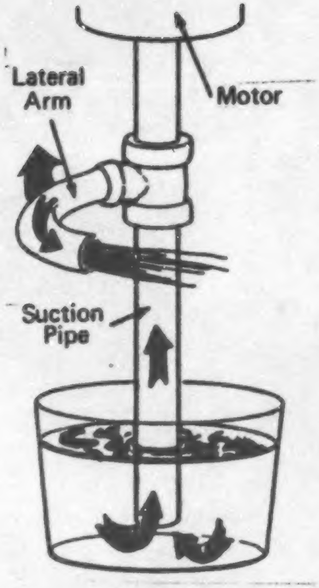

Left Chamber
Discharge Outlet
Valve Assembly
Right Chamber
Piston Rod
Plunger
Suction Inlet
(From Water Source)

Movement of plunger to the right

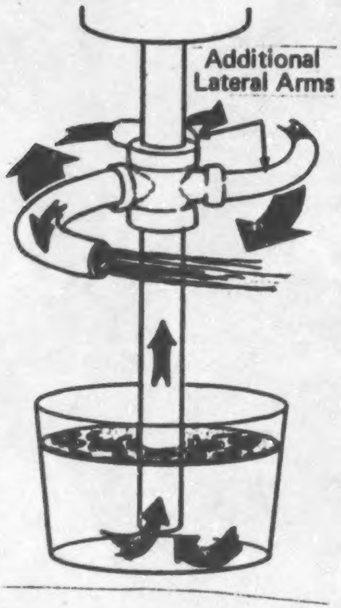

Left Chamber
Discharge Outlet
Cylinder
Suction Inlet

Movement of plunger to the left

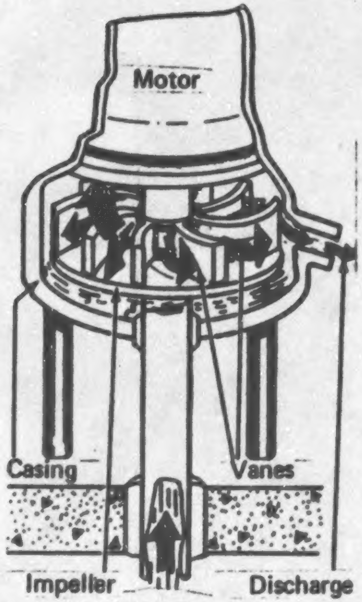
Operation of a Centrifugal Pump


Lateral Arm
Motor
Suction Pipe

L-Shape pipe rotated rapidly will pump water out of a bucket.

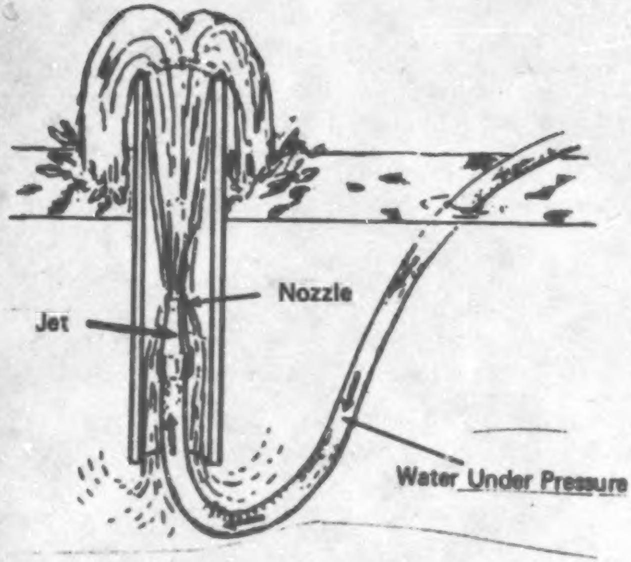

Additional Lateral Arms

More water can be pumped with addition of lateral arms.

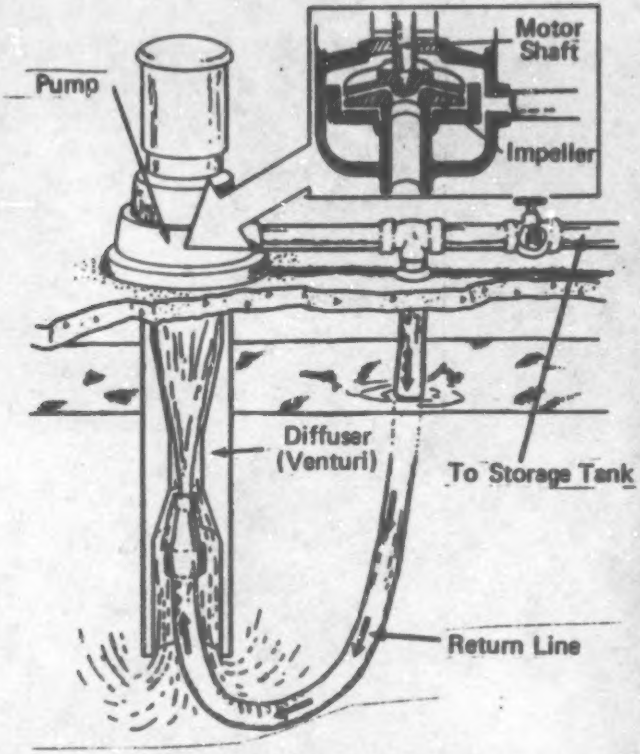

Motor
Casing
Vanes
Impeller
Discharge

Manufactured pump with impeller replacing lateral arms.

Operation of a Jet Pump


Nozzle
Jet
Water Under Pressure

Water is supplied to jet nozzle under pressure. Water surrounding the jet stream is lifted and carried up the pipe as a result of jet action.


Motor Shaft
Pump
Impeller
Diffuser (Venturi)
To Storage Tank
Return Line

Jet used with a centrifugal pump.

PRIVATE WATER SYSTEMS
UNIT I

ASSIGNMENT SHEET #1–COMPUTE THE COSTS FOR PLUMBING SUPPLIES

EVALUATION: Provided with job specifications and materials cost sheets, compute the cost for piping, fittings, pump, and all other materials used to complete job sheet #1. The total cost must be within 5% of the instructor's computation.

I. Tools and equipment

   A. Job specifications

   B. Pencil and cost sheets

   C. Job sheet #1

   D. Access to catalogs and plumbing supply wholesaler

II. Procedure

   A. Study the job specifications

   B. Complete the requirements for Job Sheet #1

   C. Visit the pump supply wholesale house to secure prices

   D. Fill out the cost sheets

   E. Check with instructor for accuracy of computation

PRIVATE WATER SYSTEMS
UNIT I

JOB SHEET #1–INSTALL A PUMP AND CONTROLS ACCORDING TO MANUFACTURER'S SPECIFICATIONS

EVALUATION: Given access to tools, equipment, and materials, install a pump and controls according to manufacturer's specifications. Piping should not leak, controls should operate the system correctly, and the workmanship should be approved by the instructor.

I. Tools and equipment

  A. Pump

  B. Pressure tank

  C. Three bricks or tank supports

  D. Two 3/4" galvanized iron tees

  E. One 3/4" galvanized iron plug

  F. One 3/4" galvanized iron 90° elbow

  G. Assorted 3/4" galvanized iron nipples (2-6", 2-5", 1-4", 2-3")

  H. Short length 3/4" galvanized iron pipe

  I. One 3/4" foot valve

  J. One 3/4" gate valve

  K. Air volume control

  L. Pressure switch

  M. Pressure gauge

  N. Relief valve (if piston pump is used)

  O. Bushing for relief valve (if used)

  P. Two 3/4" galvanized iron union

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JOB SHEET #1

Q. Pipe joint compound

R. Two 14" pipe wrenches

S. One 8" adjustable wrench

T. One 1 1/4" x 1/8" bushing

U. Two 1 1/4" x 3/4" bushings

V. Short 2" x 8" wood plank (to support pump)

W. Pipe threading equipment

X. 55 gallon tank

Y. Boiler drain

II. Procedure

(NOTE: Refer to Figure 1 on last page of job sheet.)

A. Install 6" nipple into tank inlet

(NOTE: This inlet might need a bushing.)

B. Install 5" nipple into tank outlet

C. Install 3/4" tee on outlet nipple

D. Install 3/4" boiler drain valve on end of tee

E. Install 4" nipple on side outlet of tee (vertical)

F. Install 3/4" gate valve on end of nipple

(NOTE: Apply pipe compound to all male threads.)

G. Install 3/4" union on end of tank inlet nipple

H. Raise pressure tank up to rest on bricks or supports

I. Raise pump up to rest on work plank

(NOTE: Use any material to cushion vibration.)

J. Measure distance from pump outlet to tee (end to center measurement)

K. Cut, ream, and thread discharge pipe

L. Install discharge pipe in pump outlet

M. Loosen union and install on pump discharge pipe (L)

JOB SHEET #1

N. Tighten union

O. Install 3" nipple in suction side of pump

P. Install 3/4" union, 3" nipple, elbow, 3" nipple and foot valve

Q. Install pressure control

R. Install air-volume control (including tubing)

S. Install gauge

T. Check work

U. Clean up area and tools

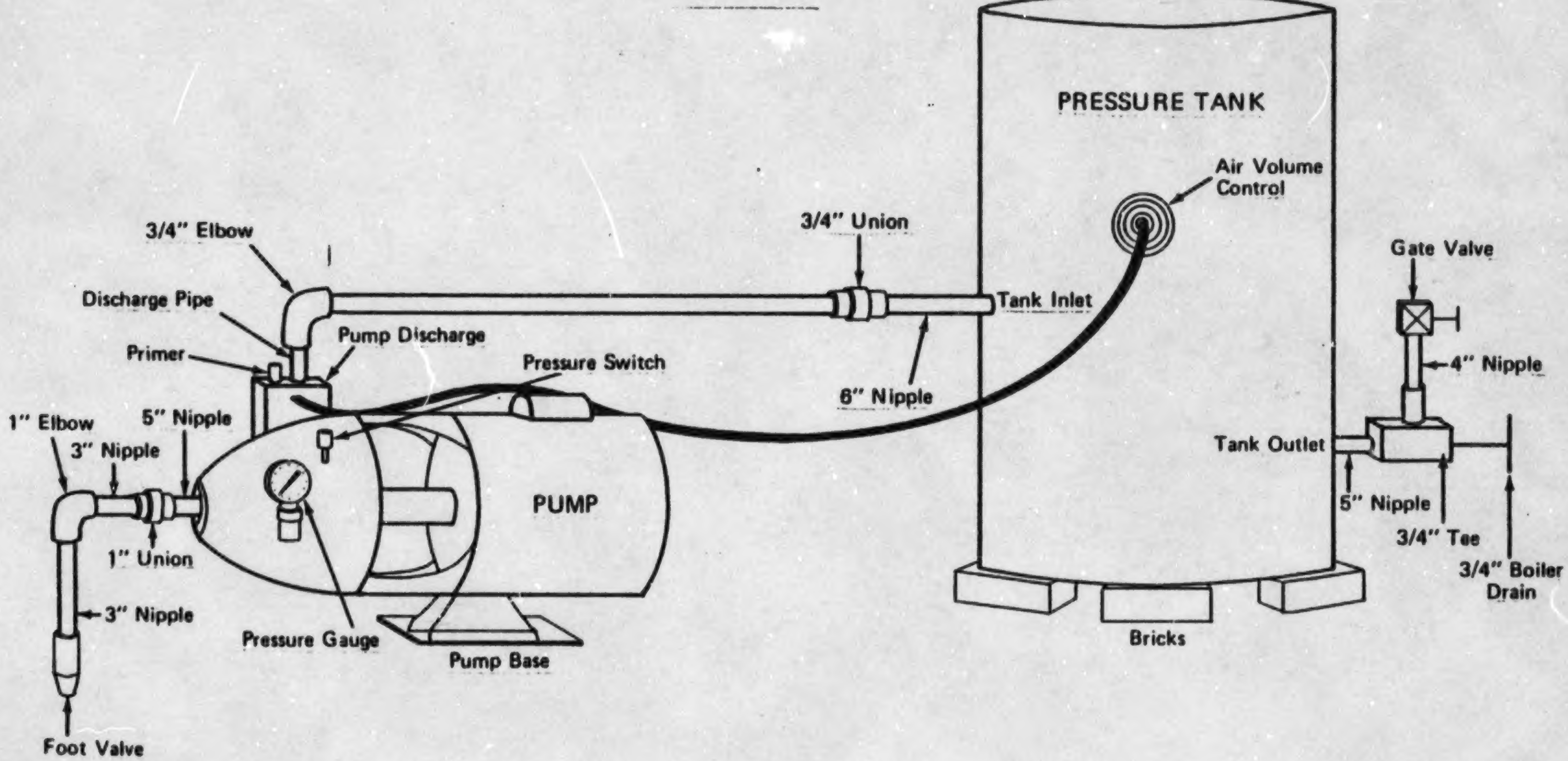
V. Put tools and equipment away

W. Check with instructor for evaluation of job

(NOTE: Installation can be tested using 55 gallon drum filled with water.)

Private Water System

FIGURE 1



PRESSURE TANK
Air Volume Control
3/4" Union
Tank Inlet
6" Nipple
3/4" Elbow
Discharge Pipe
Primer
Pump Discharge
Pressure Switch
1" Elbow
5" Nipple
3" Nipple
1" Union
3" Nipple
Foot Valve
PUMP
Pressure Gauge
Pump Base
Gate Valve
4" Nipple
Tank Outlet
5" Nipple
3/4" Tee
3/4" Boiler Drain
Bricks

PRIVATE WATER SYSTEMS
UNIT I

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

______a. Water that is free from impurities which cause disease or harmful effects

______b. A device which uses mechanical power to move or lift liquid from one point to another

______c. A safety device installed in a water system to automatically reduce excess pressure

______d. A device placed at the lower end of the suction pipe in order to keep the pipe full of water

______e. A valve which allows water to flow in only one direction

______f. Pipe which carries water from its source, such as a well or spring box, to the pump

______g. That pipe which carries water from the pump to the pressure tank or water system

______h. A device which receives the discharge from the pump and develops pressure by compressing air

______i. A water controller which is used to isolate parts of the pumping system

______j. The height to which underground water will be found in a specific location

______k. Pounds per square inch, the measurement of pressure in water systems

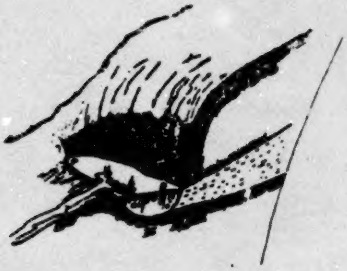
______l. Sub-soil section, usually containing clay or rock, which resists or prevents flow or absorption of water

______m. Operating in a circular motion

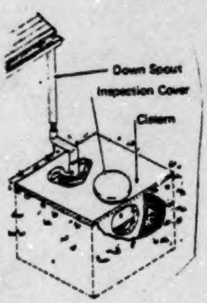
______n. Operating in a back-and-forth motion

1. Relief valve
2. Suction line
3. Gate valve
4. P.S.I.
5. Reciprocating
6. Pressure tank
7. Potable water
8. Foot valve
9. Pump
10. Check valve
11. Discharge line
12. Impervious layer
13. Centrifugal
14. Water table

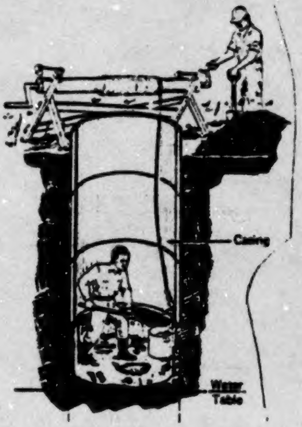
2. **Identify types of private water supplies.**



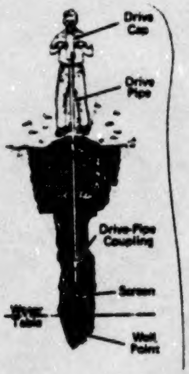
a. ______________


Down Spout
Inspection Cover
Cistern

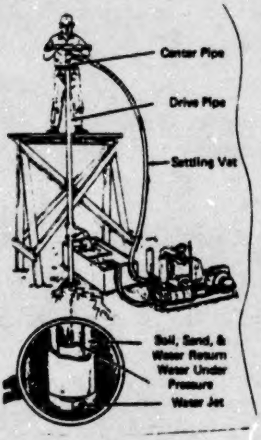
b. ______________


Casing
Water Table

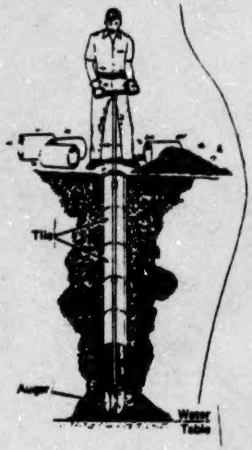
c. ______________


Drive Cap
Drive Pipe
Drive-Pipe Coupling
Screen
Water Table
Well Point

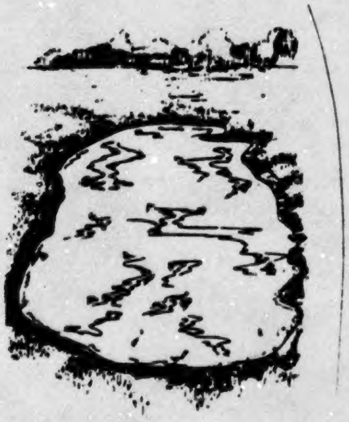
d. ______________


Center Pipe
Drive Pipe
Settling Vat
Soil, Sand, & Water Return
Water Under Pressure
Water Jet

e. ______________


Tile
Auger
Water Table

f. ______________



g. ______________

770

#2-E

3. Select true statements describing various private water supplies by placing an "X" in the appropriate blanks.

______a. A dug well consists of a hole in the ground 3 to 20 feet in diameter and deep enough to extend below the ground water table

______b. A driven well is made with an auger, either hand or power operated

______c. A spring is water that rises to the surface from some underground source

______d. A bored well consists of a pipe with a device on the lower end which is screened to allow ground water to enter the pipe

______e. A drilled well consists of a steel pipe, 4 to 6 inches in diameter, used as a casing to protect the hole from cave-ins and other disturbances

______f. Storage tanks provide water collected from rain or sub-surface ground

4. List five possible sources of contamination in private water supplies.

a.

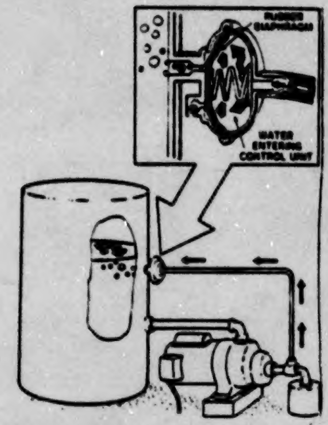
b.

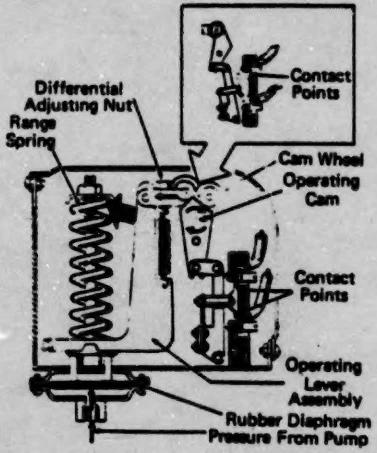
c.

d.

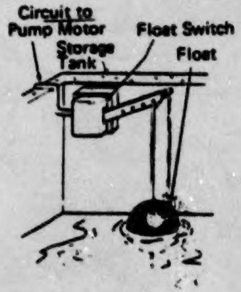
e.

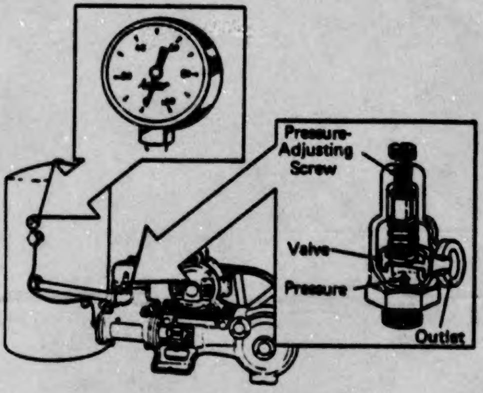
5. Identify various pump controls used on private water systems.


RUBBER DIAPHRAGM
WATER ENTERING CONTROL UNIT

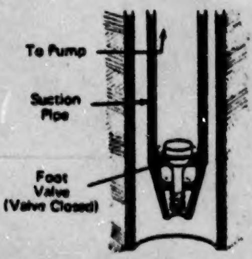

Contact Points
Differential Adjusting Nut
Range Spring
Cam Wheel
Operating Cam
Contact Points
Operating Lever Assembly
Rubber Diaphragm
Pressure From Pump

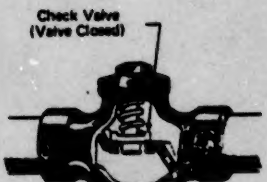
a. ______________________________ b. ______________________________


Circuit to Pump Motor
Float Switch
Storage Tank
Float

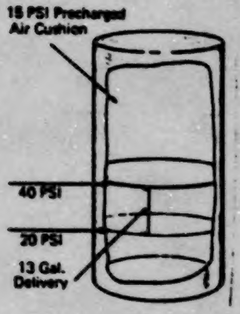

Pressure-Adjusting Screw
Valve
Pressure
Outlet

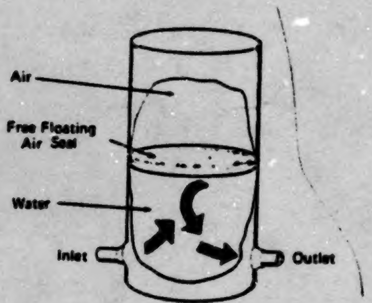
c. __________________ d. __________________ e. __________________


To Pump
Suction Pipe
Foot Valve (Valve Closed)


Check Valve (Valve Closed)

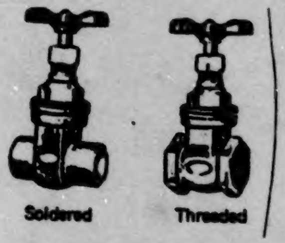
f. ______________________________ g. ______________________________

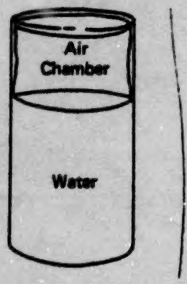

15 PSI Precharged Air Cushion
40 PSI
20 PSI
13 Gal. Delivery


Air
Free Floating Air Seal
Water
Inlet
Outlet

h. ____________________

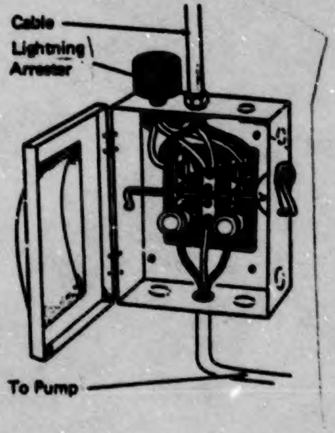
i. ____________________


Soldered
Threaded


Air Chamber
Water

j. ____________________

k. ____________________


Cable
Lightning Arrester
To Pump

l. ____________________

6. Select true statements concerning applications of various controls on private water systems by placing an "X" next to the true statements.

_____ a. Pump must be fused separately

_____ b. Local control switch should be placed near the pump for manual off-on operation

_____ c. Most pressure switches are factory set at 60-80 lbs. pressure

_____ d. Float switch controls pump operation to determine necessary pressure

_____ e. Air volume control keeps the air from being absorbed into the water

_____ f. Pressure gauges indicate storage tank pressures

_____ g. Globe valves should be used in pump installations to assure maximum flow of water

_____ h. Gate valves keep the suction pipe filled with water

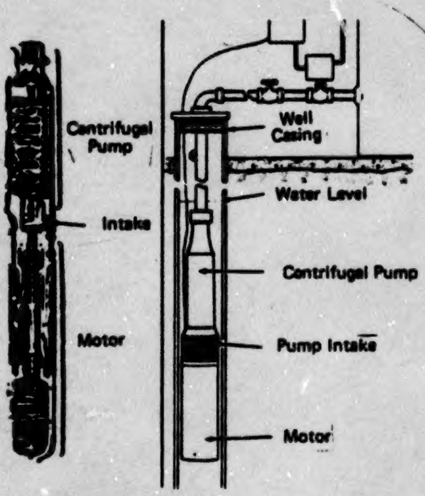
_____ i. If a pressure gauge is installed, a pressure switch is not necessary

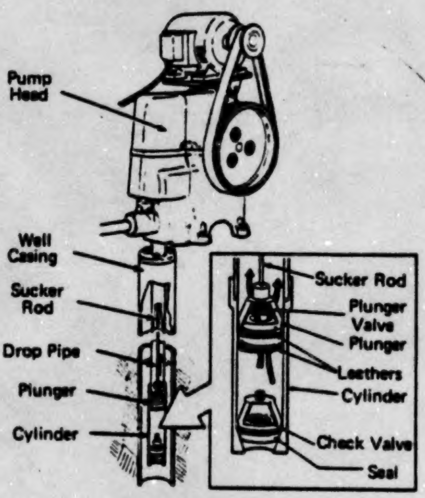
_____ j. An air-volume control replaces the air which has been absorbed by the water

_____ k. Floating air seals help to lower the air absorption rate in pressure tanks

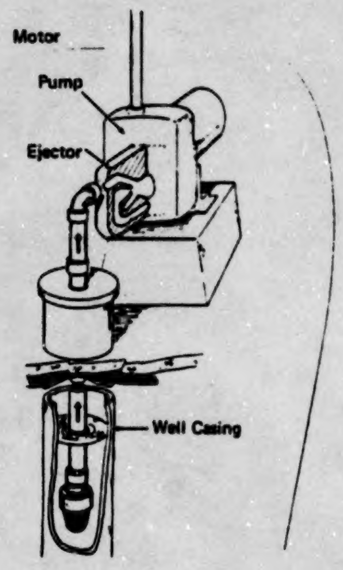
_____ l. The pressure switch controls pump operation to fill gravity storage tank

7. Identify types of pumps used for private water systems.


Centrifugal Pump
Intake
Motor
Well Casing
Water Level
Centrifugal Pump
Pump Intake
Motor


Pump Head
Well Casing
Sucker Rod
Drop Pipe
Plunger
Cylinder
Sucker Rod
Plunger Valve
Plunger
Leathers
Cylinder
Check Valve
Seal

a. ______________________ b. ______________________


Motor
Pump
Ejector
Well Casing

c. ______________________

8. Describe the operating principles of three types of pumps.

a.

b.

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c.

9. Compute the costs for plumbing supplies.

10. Demonstrate the ability to install a pump and controls according to manufacturer's specifications.

PRIVATE WATER SYSTEMS
UNIT I

ANSWERS TO TEST

1. a. 7
   b. 9
   c. 1
   d. 8
   e. 10
   f. 2
   g. 11
   h. 6
   i. 3
   j. 14
   k. 4
   l. 12
   m. 13
   n. 5

2. a. Protected spring
   b. Storage tank
   c. Dug well
   d. Washed or jetted driven well
   e. Drilled well
   f. Bored well
   g. Pond or lake

3. a, c, e, f

4. Any five of the following:
   a. Leaking sewer lines
   b. Houses treated for termite control
   c. Septic tanks
   d. Leach (absorption) fields
   e. Barnyards
   f. Flooded land
   g. Unsealed wells

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5. a. Air volume control
   b. Pressure switch
   c. Float switch
   d. Pressure gauge
   e. Pressure relief valve
   f. Foot valve
   g. Spring loaded check valve
   h. Precharged tank
   i. Floating air seal
   j. Gate valves
   k. Sealed-in air chamber
   l. Switch box

6. a, b, f, j, k

7. a. Centrifugal
   b. Piston
   c. Jet

8. Discussion should include:
   a. Piston pumps
      1) Single acting piston
         a) Suction stroke draws water into the cylinder
         b) Discharge stroke pushes water into the discharge pipe
      2) Double acting piston
         a) Movement of the plunger to the right pulls water from well into the left chamber
         b) Water is forced out of the right chamber
         c) Plunger movement to the left forces water out of left chamber
         d) Water is pulled from well into the right chamber
   b. Centrifugal pumps
      1) An L-shaped pipe, completely filled with water and rotated rapidly will pump water out of a bucket
      2) By adding more lateral arms, more water is pumped
      3) With a manufactured pump, the lateral arms are replaced with an impeller
      4) For higher pressures or greater lifts, two or more impellers are used

c. Jet pumps

   1) Water is supplied to the jet nozzle under pressure

   2) Water surrounding the jet stream is lifted and carried through the pipe as a result of the jet action

9. Evaluated to the satisfaction of the instructor

10. Performance skill evaluated to the satisfaction of the instructor

SEPTIC SYSTEMS
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to describe how a septic system operates and install a septic tank. This knowledge will be evidenced by correctly performing the procedures outlined on the job sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with septic systems to the correct definitions or descriptions.
2. Describe how a septic system operates using an illustration.
3. Select statements which correctly describe the basic design of a septic system.
4. List septic tank construction materials.
5. Discuss septic tank care.
6. Demonstrate the ability to install a septic tank.

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SEPTIC SYSTEMS
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide student with objective sheet.
- B. Provide student with information and job sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information sheets.
- F. Demonstrate and discuss the procedures outlined in the job sheets.
- G. Provide students with local plumbing code books and discuss the construction details of septic tanks.
- H. Discuss the construction of a sub-surface tile system.
- I. Contact the local sanitarian from the Board of Health to address the class on the percolation test procedure.
- J. Invite a local engineer or sanitarian to discuss the minimum standards, location, and design of residential lagoons.
- K. Visit the site of a septic tank installation.
- L. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete job sheets.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet

C. Transparency masters

  1. TM 1–Components of Private Sewage Disposal Systems
  2. TM 2–Basic Design of a Septic System
  3. TM 3–Construction Methods and Materials

D. Job Sheet #1–Install a Septic Tank

E. Test

F. Answers to test

II. Reference–*Septic Tank and Subsurface Tile Systems.* Oklahoma State Department of Health, January, 1978.

III. Additional reference: *Manual for Septic Tank Practice.* Public Health Service Publication No. 526. Washington, D.C.: U.S. Government Printing Office.

SEPTIC SYSTEMS
UNIT II

INFORMATION SHEET

I. Terms and definitions

A. Septic--Destructive action of bacteria on organic matter

(NOTE: An anti-septic such as a mouthwash kills bacteria and counteracts the destructive action.)

B. Septic tank--A waterproof tank in a private sewage disposal system which promotes the growth and reproduction of bacteria in order to break up and decompose organic matter (Transparency 1)

C. Percolation test--A test to determine the ability of the soil to absorb water

D. Leach field--A piping installation designed to disperse the septic tank discharge into the soil to be evaporated or absorbed

E. Distribution box--A small tank taking the immediate discharge of the septic tank and distributing it in two or more directions

F. Effluent--The discharge which flows out of a septic tank

G. Perforated pipe--Pipe with holes in the side which allow liquid to be released into the ground

H. Cesspool--A pit or well constructed of brick, stone, or block, without any masonry (cement bond), used to receive sewage discharge from a building (Transparency 1)

I. Sludge--Solids which settle to the bottom of a tank or pit

J. Anaerobic bacteria--Bacteria that live and grow in the absence of oxygen

K. Aerobic bacteria--Bacteria that live and grow in the presence of oxygen

L. Lagoon--Small pond taking the effluent from the septic tank when tile field drainage is insufficient

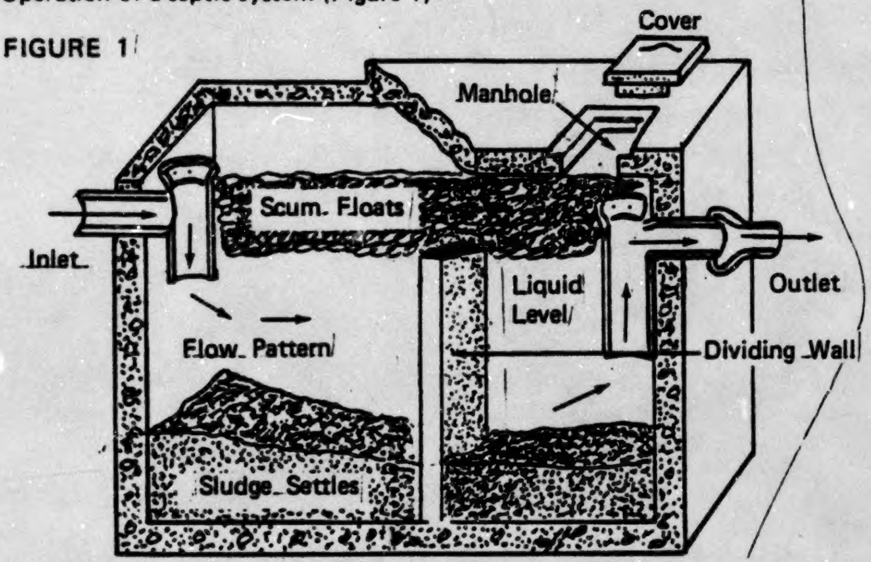
M. Leaching pit--A perforated masonry tank used to disperse the effluent from a septic tank (Transparency 1)

I-57-E

INFORMATION SHEET

II. Operation of a septic system (Figure 1)

FIGURE 1



A. The septic tank receives the discharge from soil pipes which extend beyond the building walls

B. Organic solids settle to bottom of tank

C. Bacteria decompose the solids and somewhat clarify the liquid

D. The liquid leaves the septic tank by gravity and enters the leaching field

E. The liquid is dispersed into the soil, sand and/or gravel to be evaporated at the ground surface or to be drained into the ground

III. Basic design of a septic system (Transparency 2)

(NOTE: Refer to local codes.)

A. The sewage disposal system should consist of a septic tank with effluent discharging into a sub-surface tile system

B. All waste water must be connected to the disposal system, including laundry and kitchen wastes

C. Septic systems are designed for a maximum water usage of 8,000 gallons per month for a 2 and 3 bedroom residence, and 10,000 gallons per month for a 4 bedroom residence

(NOTE: Systems using more than this amount of water cannot be expected to perform properly.)

INFORMATION SHEET

D. All parts of the disposal system should be located 50 feet (minimum) from any water supply when the ground slopes from the water well and conditions are favorable

(NOTE: When ground elevations or other unfavorable conditions indicate danger to a water supply, this distance should be increased to 100 feet or more.)

E. All parts of the sewage disposal system except the septic tank and connecting house sewer (i.e., sub-surface tile, distribution or retention boxes) should be located at least 10 feet from dwellings, garages or other structures, and 15 feet from water lines

F. The septic tank should be located a minimum of 5 feet from dwellings, garages, or other structures

G. Under favorable drainage and soil conditions, all parts of the system should be located a minimum of 5 feet from property lines

H. The minimum size septic tank shall be 1,000 gallons liquid capacity for each dwelling or living unit with 4 bedrooms or less, with 250 gallons additional liquid capacity for each additional bedroom above 4

(NOTE: For special situations, 500 gallon tanks might be acceptable.)

IV. Septic tank construction materials (Transparency 3)

A. Reinforced (wire mesh) concrete

B. #12 gauge steel coated with bituminous material

C. Cement blocks

D. Fiberglass

E. Plastic

V. Septic tank care

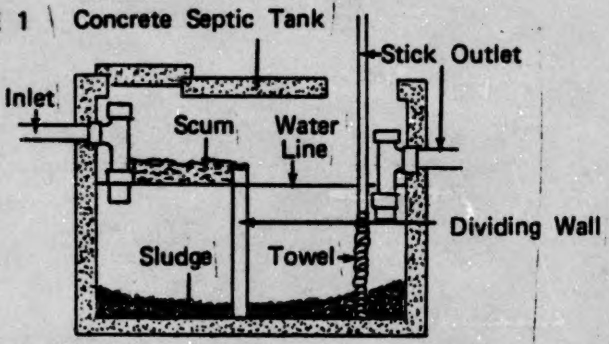
A. There is no set period of time to clean out a septic tank, but it should be checked every two years to determine if cleaning is necessary

B. To determine when the septic tank needs to be cleaned, remove the cover or inspection port and obtain a piece of lumber 1" x 2" x 8' and wrap and nail cloth toweling to the bottom three feet of the lumber

C. Lower the toweled end into the tank slowly until the bottom of the tank is reached

D. Hold in this position for several minutes, then remove the measuring device from the tank as gently as possible (Figure 1)

FIGURE 1



E. The dark colored sludge will discolor the toweling, denoting the total depth of sludge accumulation

F. When depth of the sludge exceeds 24 inches, it is time to have the septic tank cleaned by a licensed septic tank cleaner

G. A properly cleaned septic tank is one that has all the liquid, scum, sludge, and solids removed

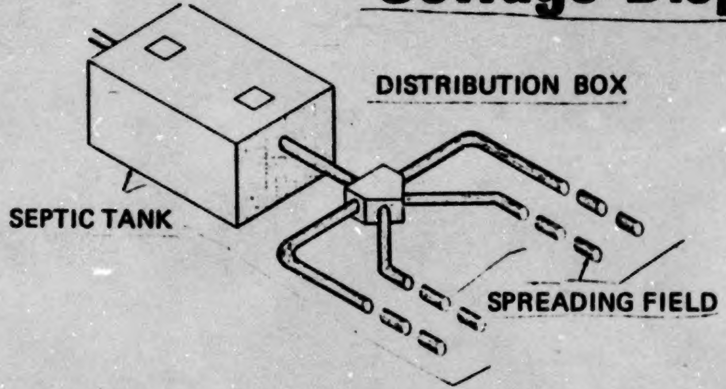
H. A gallon of the sludge should be left in the tank for a bacterial starter

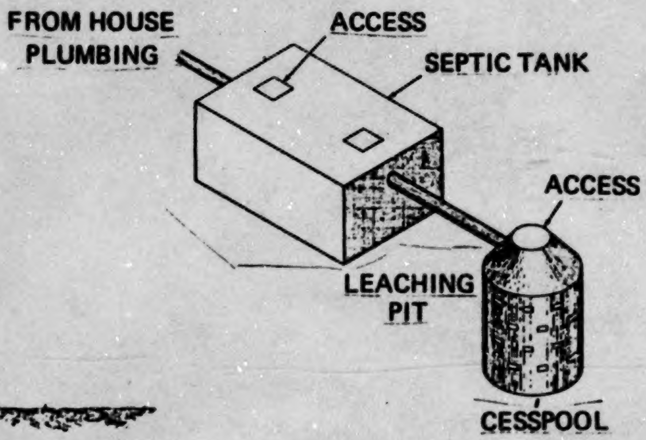
(NOTE: The addition of additives to the tank such as yeast, enzymes, bacteria, etc., is not necessary for digestion within the tank.)

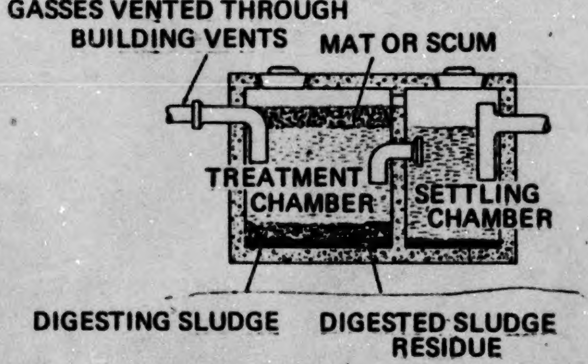
I. The normal use of bleaches, detergents, soaps, and drain cleaners does not harm or interfere with the normal operation of the system

(NOTE: The scum forming on top of the liquid often becomes so thick that the effectiveness of the system becomes limited. The scum must then be removed.)

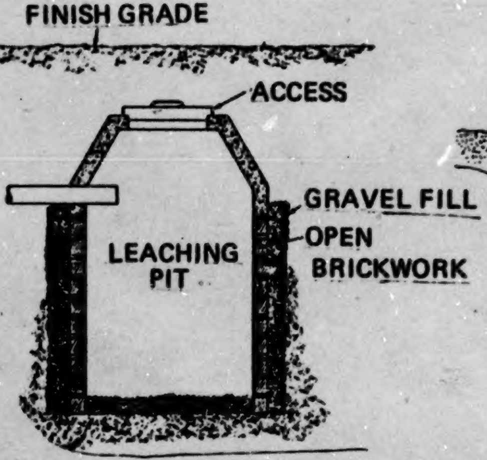
Componets of Private Sewage Disposal Systems

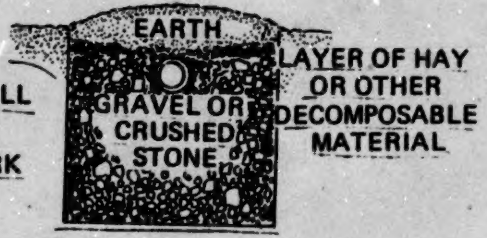

DISTRIBUTION BOX
SEPTIC TANK
SPREADING FIELD


FROM HOUSE PLUMBING
ACCESS
SEPTIC TANK
ACCESS
LEACHING PIT
CESSPOOL


GASSES VENTED THROUGH BUILDING VENTS
MAT OR SCUM
TREATMENT CHAMBER
SETTLING CHAMBER
DIGESTING SLUDGE
DIGESTED SLUDGE RESIDUE

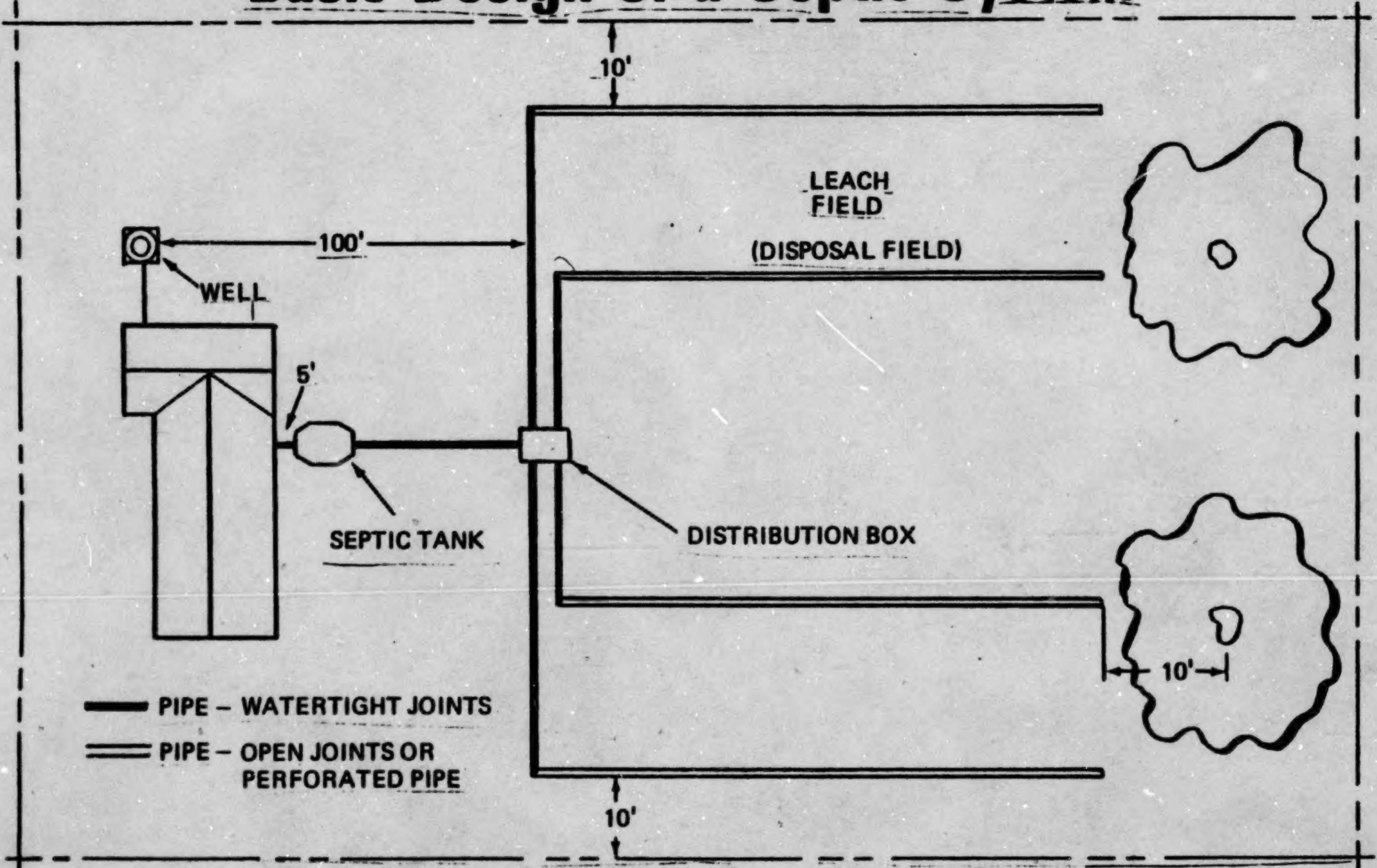
Two Compartment Septic Tank


FINISH GRADE
ACCESS
GRAVEL FILL
OPEN BRICKWORK
LEACHING PIT


EARTH
LAYER OF HAY OR OTHER DECOMPOSABLE MATERIAL
GRAVEL OR CRUSHED STONE

Cross Section of Leach Field

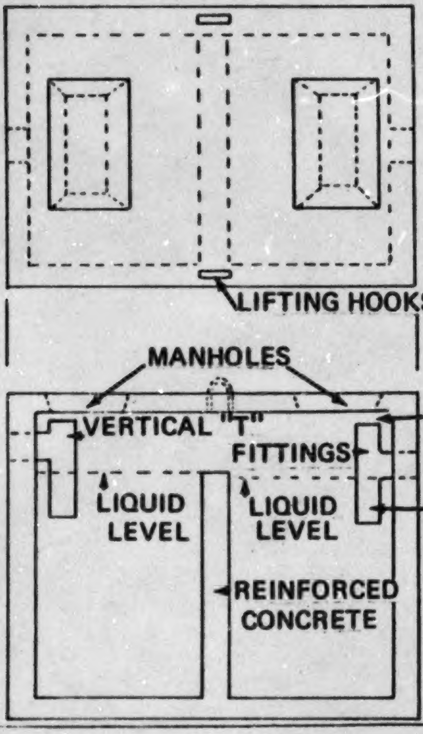
Basic Design of a Septic System


10'
LEACH FIELD
(DISPOSAL FIELD)
100'
WELL
5'
SEPTIC TANK
DISTRIBUTION BOX
10'
PIPE – WATERTIGHT JOINTS
PIPE – OPEN JOINTS OR PERFORATED PIPE
10'

Typical Layout for a Private Waste Disposal System

Construction Methods and Materials

TANKS MUST BE WATER TIGHT



LIFTING HOOKS

MANHOLES

INLET

VERTICAL "T" FITTINGS

WITHIN 1" OF TOP OF TANK

OUTLET

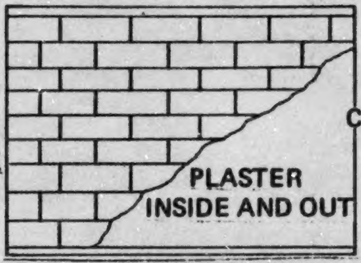
LIQUID LEVEL

LIQUID LEVEL

TO EXTEND BELOW LIQUID LEVEL

REINFORCED CONCRETE

TYPICAL PRECAST CONCRETE TANK
3000 lbs. MINIMUN STRENGTH CONCRETE



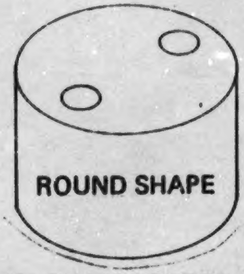
POURED CONCRETE TOP

CEMENT PLASTER

CEMENT BLOCK

PLASTER INSIDE AND OUT

CONCRETE BASE



ROUND SHAPE

STEEL TANK COATED
WITH BITUMINOUS MATERIAL

JOB SHEET #1--INSTALL A SEPTIC TANK

EVALUATION: Given a backhoe and operator, septic tank and top, shovel, builder's level, measuring tape, sledge hammer and felt, install a septic tank. The top of the septic tank must be positioned at least 8" below the finished grade so that equal length drain fields can be constructed.

(NOTE: By using a scale model and substitute tools and equipment, this task can be performed in the plumbing shop.)

I. Tools and equipment

- A. Builder's level and tripod
- B. 6' rule or steel tape
- C. Backhoe and operator
- D. Pointed shovel
- E. Level
- F. Roll of roofing felt
- G. Drain pipe
- H. Sand, cement, and water
- I. Small pointed trowel

II. Procedure

(NOTE: Refer to local codes.)

- A. Establish grade at drain pipe stubbed out of building, using a builders level
- B. Measure distance from building stub to point where drain line will enter tank

  (NOTE: Allow for a 1/4" slope per foot of drain line.)
- C. Measure septic tank and determine required depth of hole
- D. Dig hole to required depth, width, and length with backhoe

  (NOTE: Remove earth as necessary with a shovel.)

  (CAUTION: Demonstrate extreme caution while in or near excavating procedures.)

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JOB SHEET #1

E. Lift tank and position it in hole with the backhoe

F. Level the tank, checking the length and width

G. Connect drain to septic tank using sand, cement, and water mixture

(NOTE: Make a neat joint at the tank using a small pointed trowel.)

H. Cover top of tank with roofing felt

I. Pack earth firmly around sides and top of tank

J. Remove excess earth

K. Check with instructor for approval of job

L. Clean up the area and return all tools and equipment

(NOTE: In poor drainage soils, tanks should be partially filled with water; even concrete tanks can float after severe rains.)

SEPTIC SYSTEMS
UNIT II

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Destructive action of bacteria or organic matter

_____b. A waterproof tank in a private sewage disposal system which promotes the growth and reproduction of bacteria to break up and decompose organic matter

_____c. A test used to determine the ability of the soil to absorb water

_____d. A piping installation designed to disburse the septic tank discharge into the soil to be evaporated or absorbed

_____e. A small tank taking the immediate discharge of the septic tank and distributing it in two or more directions

_____f. The discharge which flows out of a septic tank

_____g. Pipe with holes in the side to allow liquid to be released into the ground

_____h. A pit or well constructed of brick, stone, or block, without any masonry (cement bond), used to receive sewage discharge from a building

_____i. Solids which settle to the bottom of a tank or pit

_____j. Bacteria that live and grow in the absence of oxygen

_____k. Bacteria that live and grow in the presence of oxygen

_____l. Small pond tanking the effluent from the septic tank when tile field drainage is insufficient

_____m. A perforated masonry tank used to disperse effluent from a septic tank

1. Percolation test
2. Distribution box
3. Effluent
4. Cesspool
5. Sludge
6. Septic
7. Aerobic bacteria
8. Lagoon
9. Anaerobic bacteria
10. Septic tank
11. Leach field
12. Perforated pipe
13. Leaching pit

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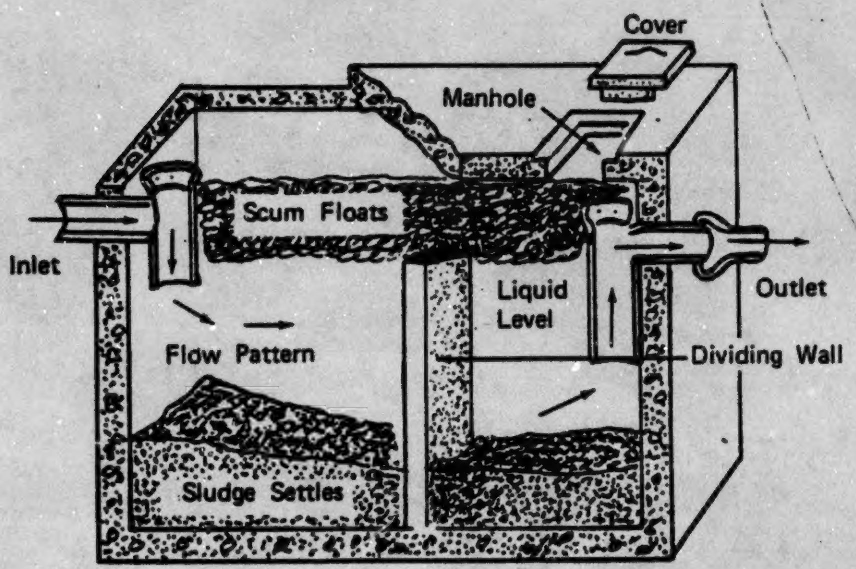
2. Describe how a septic system operates using the following illustration.


Cover
Manhole
Scum Floats
Inlet
Liquid Level
Outlet
Flow Pattern
Dividing Wall
Sludge Settles

a.

b.

c.

d.

e.

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3. Select statements which correctly describe the basic design of a septic system by placing an "X" in the appropriate blanks.

______a. The sewage disposal system should consist of a septic tank with effluent discharging into a sub-surface tile system

______b. All waste water must be connected to the disposal system, except laundry and kitchen wastes

______c. Septic systems are designed for a maximum water usage of 8,000 gallons per month for a 2 and 3 bedroom residence, and 10,000 gallons per month for a 4 bedroom residence

______d. All parts of the disposal system should be located 50 feet (minimum) from any water supply when the ground slopes from the water well and conditions are favorable

______e. All parts of the sewage disposal system except the septic tank and connecting house sewer (i.e., sub-surface tile, distribution or retention boxes) should be located at least 10 feet from dwellings, garages or other structures and 15 feet from water lines

______f. The septic tank should be located a minimum of 20 feet from dwellings, garages, or other structures

______g. All parts of the system should be located a minimum of 5 feet from property lines under favorable drainage and soil conditions

4. List four septic tank construction materials.

a.

b.

c.

d.

5. Discuss septic tank care.

6. Demonstrate the ability to install a septic tank.

(NOTE: If this activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

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SEPTIC SYSTEMS
UNIT II

ANSWERS TO TEST

1. a. 6
   b. 10
   c. 1
   d. 11
   e. 2
   f. 3
   g. 12
   h. 4
   i. 5
   j. 9
   k. 7
   l. 8
   m. 13

2. Description should include:

   a. The septic tank receives the discharge from soil pipes which extend beyond the building walls

   b. Organic solids settle to bottom of tank

   c. Bacteria decompose the solids and somewhat clarify the liquid

   d. The liquid leaves the septic tank by gravity and enters the leaching field

   e. The liquid is dispersed into the soil, sand and/or gravel to be evaporated at the ground surface or to be drained into the ground

3. a, c, d, e, g

4. Any four of the following:

   a. Reinforced (wire mesh) concrete

   b. #12 gauge steel coated with bituminous material

   c. Cement blocks

   d. Fiberglass

   e. Plastic

5. Discussion should include:

   a. There is no set period of time to clean out a septic tank, but it should be checked every two years to determine if cleaning is necessary

P-13-E

b. To determine when the septic tank needs to be cleaned, remove the cover or inspection port and obtain a piece of lumber 1" x 2" x 8' and wrap and nail cloth toweling to the bottom three feet of the lumber

c. Lower the toweled end into the tank slowly until the bottom of the tank is reached

d. Hold in this position for several minutes, then remove the measuring device from the tank as gently as possible

e. The dark colored sludge will discolor the toweling, denoting the total depth of sludge accumulation

f. When depth of the sludge exceeds 24 inches, it is time to have the septic tank cleaned by a licensed septic tank cleaner

g. A properly cleaned septic tank is one that has all the liquid, scum, sludge, and solids removed

h. A gallon of the sludge should be left in the tank for a bacterial starter

i. The normal use of bleaches, detergents, soaps, and drain cleaners does not harm or interfere with the normal operation of the system

6. Performance skill evaluated to the satisfaction of the instructor.

WATER TREATMENT
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify methods of disinfecting water and match the conditions of water quality to the means used to control them. The student should also be able to prepare a water sample for analysis by a state testing laboratory. This knowledge will be evidenced by correctly performing the procedures outlined on the job sheet and scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with water treatment to the correct descriptions or definitions.
2. Identify five methods of disinfecting water.
3. State the probable causes of poor water quality conditions when given the symptoms.
4. Match the conditions of water quality to the means used to control them.
5. Demonstrate the ability to prepare a water sample for analysis by a state testing laboratory.

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WATER TREATMENT
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:

  A. Provide student with objective sheet.

  B. Provide student with information and job sheets.

  C. Make transparencies.

  D. Discuss unit and specific objectives.

  E. Discuss information sheet.

  F. Demonstrate and discuss the procedures outlined in the job sheet.

  G. Make a field trip to a town water conditioning plant.

  H. Have a manufacturer's representative address the class.

  I. Show an automatic water softener to the class.

  J. Have a county health representative visit the class

  K. Demonstrate the use of a water testing kit

  L. Give test.

II. Student:

  A. Read objective sheet.

  B. Study information sheet.

  C. Complete job sheet.

  D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

  A. Objective sheet

  B. Information sheet

  C. Transparency masters

    1. TM 1–Methods of Disinfecting Home Water Supplies

    2. TM 2--Chlorine Methods of Disinfecting Water

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3. TM 3--Chlorine Tablet Method of Disinfecting Water
4. TM 4--Pasteurization Method of Disinfecting Water
5. TM 5--Ultra-Violet Light Method of Disinfecting Water
6. TM 6--Manual-Type Softener
7. TM 7--Means of Controlling Water Quality
8. TM 8--Means of Controlling Water Quality (Continued)
9. TM 9--Means of Controlling Water Quality (Continued)
10. TM 10--Turbidity Control

D. Job Sheet #1--Prepare a Water Sample for Analysis by a State Testing Laboratory

E. Test

F. Answers to test

II. References:

A. Ministry of Colleges and Universities. *Plumbing Module E-9, Water Softeners.* Ontario, Canada, 1978.

B. Henderson, G.E. *Planning for an Individual Water System.* Athens, Georgia: American Association for Vocational Instructional Materials, 1973.

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WATER TREATMENT
UNIT III

INFORMATION SHEET

I. Terms and definitions or descriptions

   A. Safe water--Water which is relatively free from harmful bacteria, viruses, parasites, and radiation

   B. Contamination--A source which makes water unwholesome, impure, or undesirable for use or consumption

   C. Pollution--Physical sources which contaminate water

   D. Water conditioning--Correcting quality problems of water supply

   E. Corrosive--Weakening or destroying by chemical action

   F. Dosage--Total amount of chlorine added to water in parts per million (ppm)

   G. Demand--Chlorine used up in reaction to organic matter

   H. Residual--Amount of chlorine solution which is left over after its killing action is "used up"

   I. Osmosis--The passage of fresh water through a special membrane into the side of a tank containing salt water

   J. Reverse osmosis--By applying pressure to water on the side containing salt or hardness particles, water is forced to move back through the membrane, cleansing it of the soluble materials it contains

   K. Ion--Individual or groups of atoms that carry an electrical charge

   L. Ion exchange--The process of exchanging the hard calcium and magnesium ions for soft sodium ions

   M. Zeolite--Sand-like water softening material

II. Methods used for disinfecting water (Transparency 1)

   A. Chlorine method

      1. Methods of injection into water

         a. Pump (Transparency 2)

         b. Injector (Transparency 2)

INFORMATION SHEET

        c. Tablet (Transparency 3)

        (NOTE: One to five parts of chlorine are added to 1,000,000 parts of water. This is commonly referred to as parts per million or "ppm.")

    B. Pastuerization method (Transparency 4)

    C. Ultra-violet light method (Transparency 5)

    (NOTE: The killing action is the same as that provided by sunlight in killing bacteria in open streams.)

III. Factors which correctly determine the probable cause of poor water quality

    A. Hardness

        1. Symptoms

            a. Sticky curd forms when soap is added to water

            b. Causes well-recognized ring in bathtub

            c. The harder the water, the more soap required to form suds

            d. Glassware appears streaked and murky

            e. Hard, scaly deposits form inside metal pipes

            f. Skin roughens from washing

        2. Probable causes

            a. Calcium and magnesium in the water

            (NOTE: This may be in the form of bicarbonates, sulfates, or chlorides.)

            b. Iron

    B. Red water

        1. Symptoms

            a. Red stains appear on clothes and porcelain plumbing fixtures

            b. Causes corrosion of steel pipes

            c. Water has metallic taste

d. Freshly-drawn water sometimes appears clear at first, but after exposure to air, rust particles form and settle to bottom of container

e. Red slime develops in toilet tanks

2. Probable cause

a. Dissolved iron (sometimes including manganese)

(NOTE: This is caused by the dissolving action of water as it passes through underground iron deposits, or contacts iron and steel surfaces.)

b. Iron bacteria

(NOTE: Iron bacteria is caused by living organisms (bacteria) that act on iron already in the water. This is often associated with acid or other corrosive conditions.)

C. Brownish-black water

1. Symptoms

a. Fixtures stain brownish-black

b. Fabrics stain black

c. Coffee and tea have bitter taste

2. Probable cause

a. Manganese is present usually along with iron

b. Manganese bacteria

D. Acidity

1. Symptoms —

a. "Eats away" copper and steel parts on pump, piping, tank and fixtures

b. If copper or brass are being "eaten," water may leave green stains on plumbing fixtures under a dripping faucet

c. If water contains iron, iron-removal methods are less effective

INFORMATION SHEET

2. Probable cause

   a. Water contains carbon dioxide picked up from air, or from decaying vegetable matter which combines with water to form a weak acid

   b. In rare instances, water may contain mineral acid such as sulfuric, nitric, or hydrochloric acids

E. "Rotten egg" odor and flavor

1. Symptoms

   a. "Eats away" copper and steel parts on pump, piping, tank and fixtures

   b. If sulphur and iron are both present in water, finely-divided black particles may develop which is commonly called "black water"

      (NOTE: Silverware turns black.)

   c. Not satisfactory for cooking

2. Probable cause

   a. Hydrogen-sulphide gas

   b. Sulphate-reducing bacteria

   c. Sulphur bacteria

F. Other off flavors

1. Symptom--Water may taste bitter, brackish, oily, salty, or have a chlorine odor or taste

2. Probable cause

   a. Extremely high mineral content

   b. Presence of organic matter

   c. Excess chlorine

   d. Water passage through areas containing salty or oily waste

G. Turbidity

  1. Symptom--Water with a dirty or muddy appearance

  2. Probable cause

    a. Silt

    b. Sediment

    c. Small organisms

    d. Organic matter

IV. Means of controlling water quality

A. Hard water

  1. Water softener (Transparency 6)

  2. Reverse-osmosis unit (Transparency 7)

B. Iron

  1. Phosphate feeder (Transparency 7)

  2. Ion-exchange units (zeolite water softeners) (Transparency 8)

  3. Oxidizing filters (water softener using manganese treated green sand)

  4. Chlorinator-and-filter units (Transparency 8)

C. Manganese

  1. Phosphate feeder

  2. Ion-exchange units

  3. Oxidizing filters

  4. Chlorinator-and-filter units

D. Acid water--Soda ash or caustic-soda feeder (Transparency 8)

E. Off flavor

  1. Activated-carbon filter (cartridge type) (Transparency 9)

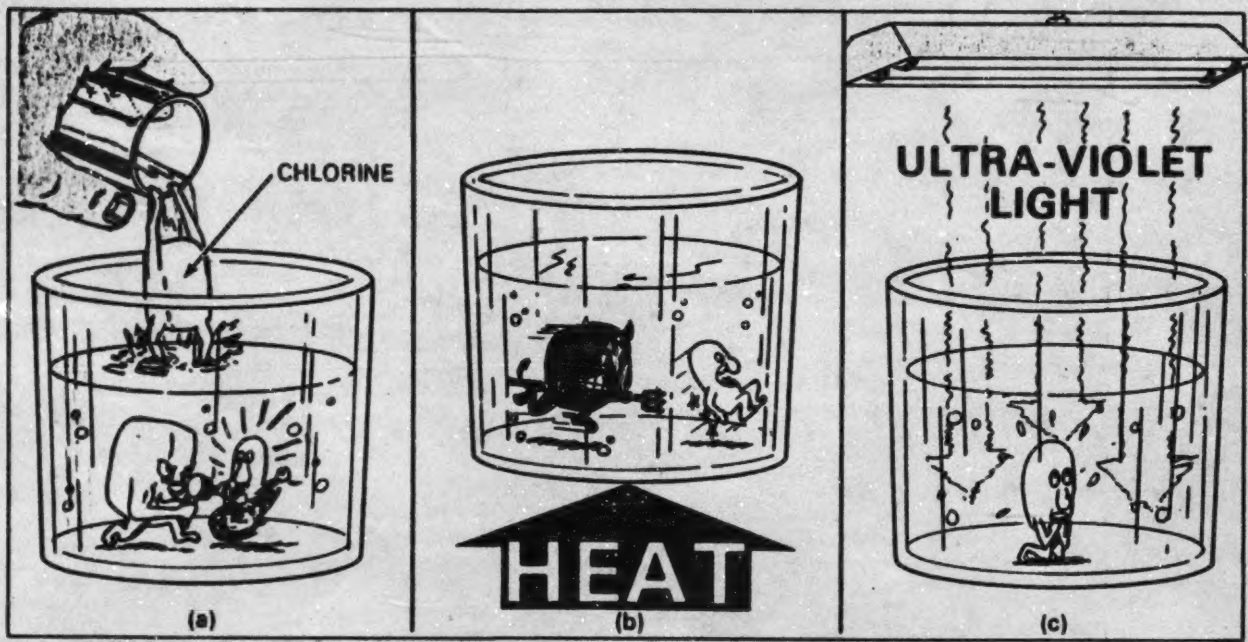
  2. Activated-carbon filter (carbon bed type) (Transparency 9)

INFORMATION SHEET

F. Turbidity

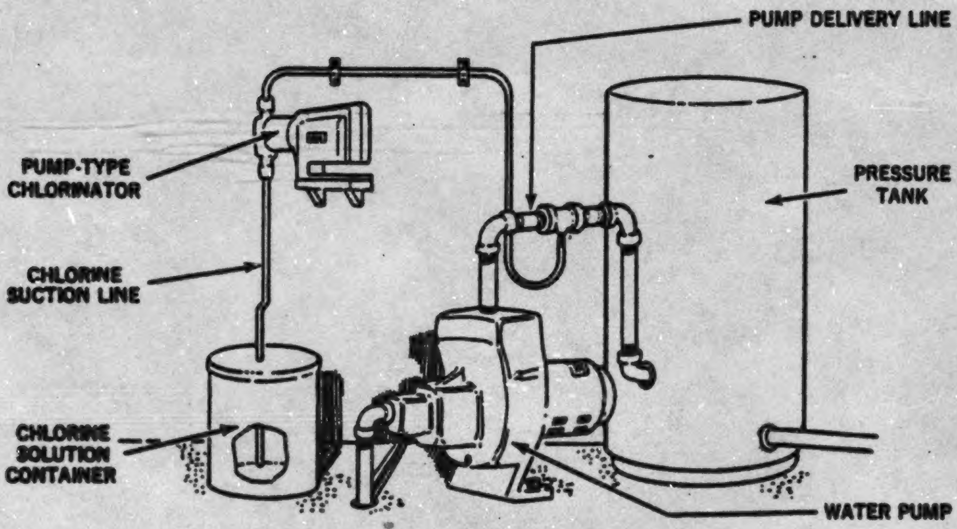
1. Open pond treatment (Transparency 10)
2. Treatment systems
   a. Sedimentation and filtering system
   b. Diatomite filter
   c. Rapid sand filter (Transparency 10)

Methods Of Disinfecting Home Water Supplies

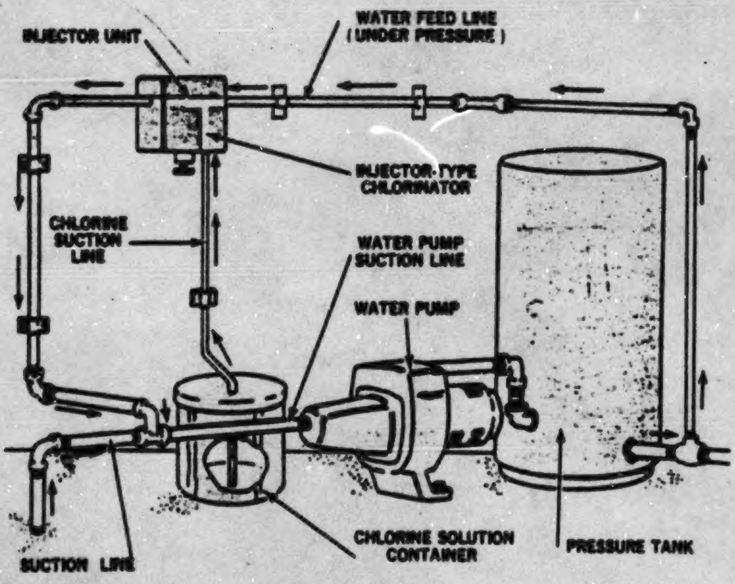

CHLORINE
HEAT
ULTRA-VIOLET LIGHT
(a)
(b)
(c)

Means used for disinfecting home water supplies. (a) Use of chlorine in water. (b) Use of heat. (c) Use of ultra-violet light.

Chlorine Methods Of Disinfecting Water

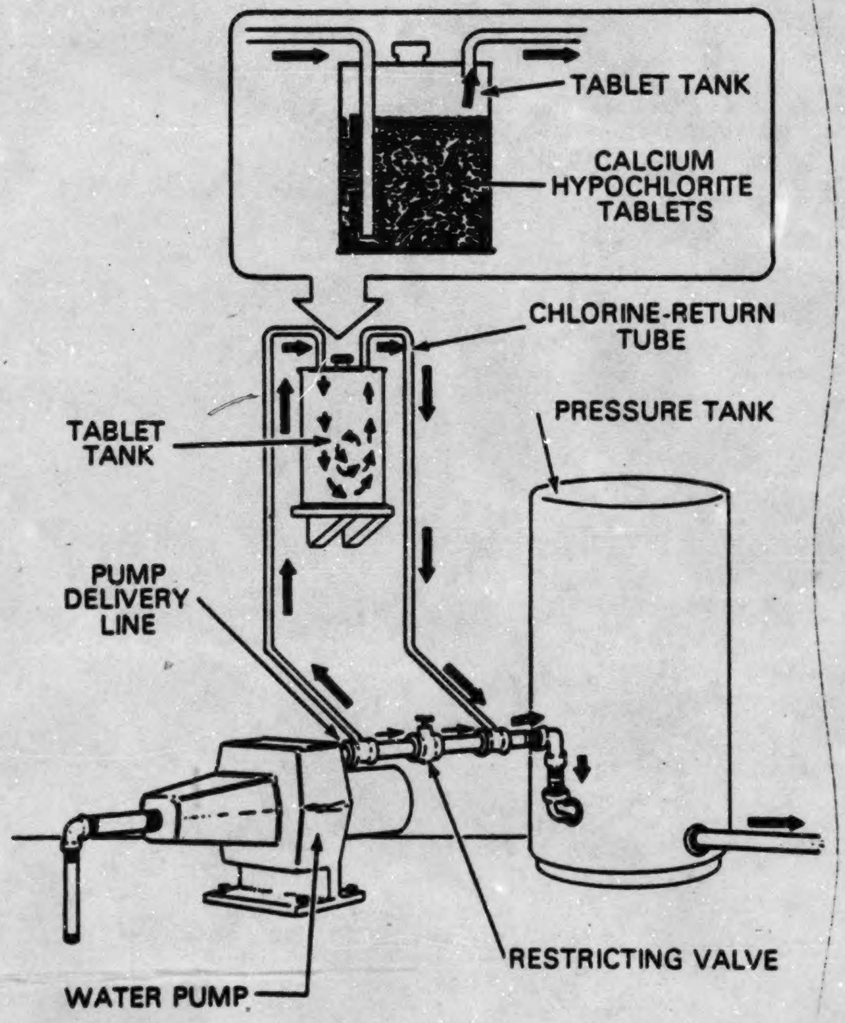

PUMP DELIVERY LINE
PUMP-TYPE CHLORINATOR
PRESSURE TANK
CHLORINE SUCTION LINE
CHLORINE SOLUTION CONTAINER
WATER PUMP

Pump Type Diaphragm Chlorinator


INJECTOR UNIT
WATER FEED LINE (UNDER PRESSURE)
INJECTOR-TYPE CHLORINATOR
CHLORINE SUCTION LINE
WATER PUMP SUCTION LINE
WATER PUMP
CHLORINE SOLUTION CONTAINER
PRESSURE TANK
SUCTION LINE

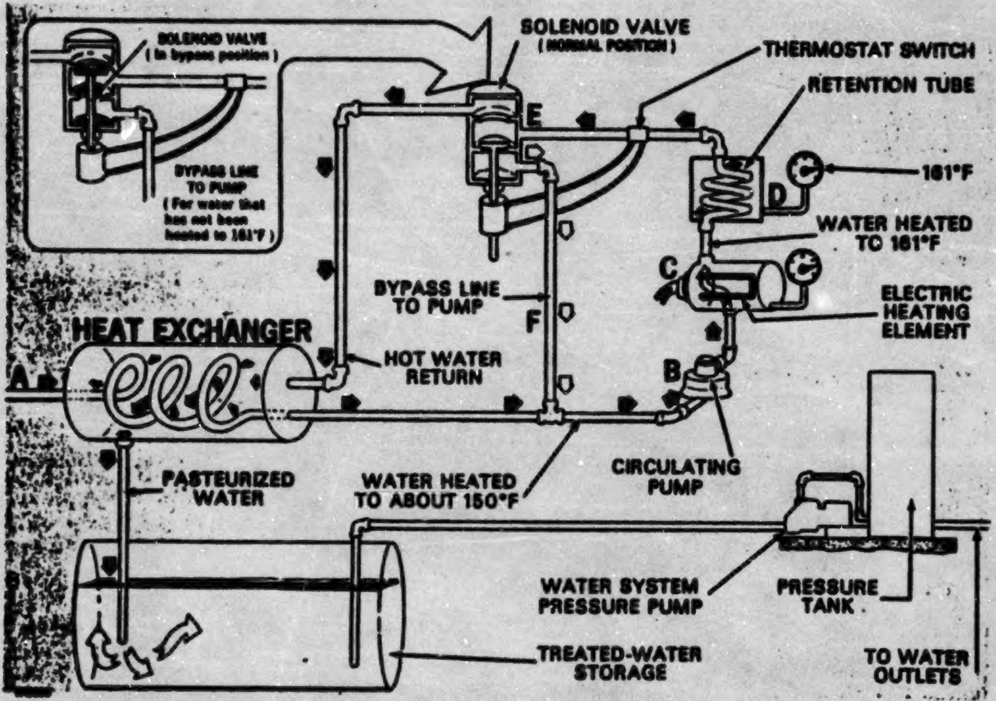
Injector Type Chlorinator

Chlorine Tablet Method Of Disinfecting Water


TABLET TANK
CALCIUM HYPOCHLORITE TABLETS
CHLORINE-RETURN TUBE
PRESSURE TANK
TABLET TANK
PUMP DELIVERY LINE
RESTRICTING VALVE
WATER PUMP

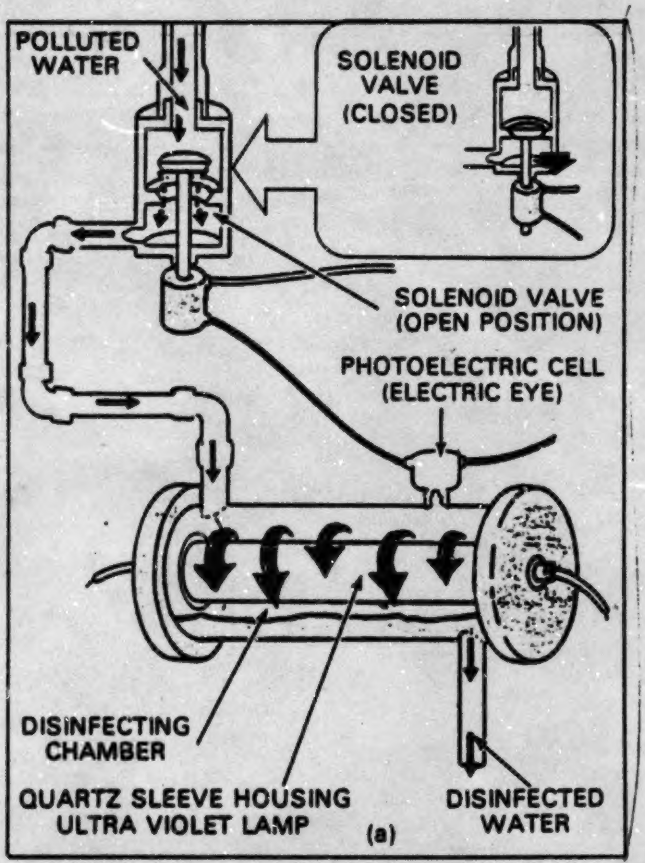
Tablet-type Chlorinator

Pastuerization Method Of Disinfecting Water


SOLENOID VALVE
(In bypass position)
BYPASS LINE
TO PUMP
(For water that
has not been
heated to 161°F)
SOLENOID VALVE
(NORMAL POSITION)
THERMOSTAT SWITCH
RETENTION TUBE
E
D
161°F
WATER HEATED
TO 161°F
C
ELECTRIC
HEATING
ELEMENT
BYPASS LINE
TO PUMP
F
HEAT EXCHANGER
A
HOT WATER
RETURN
B
CIRCULATING
PUMP
PASTEURIZED
WATER
WATER HEATED
TO ABOUT 150°F
WATER SYSTEM
PRESSURE PUMP
PRESSURE
TANK
TREATED-WATER
STORAGE
TO WATER
OUTLETS

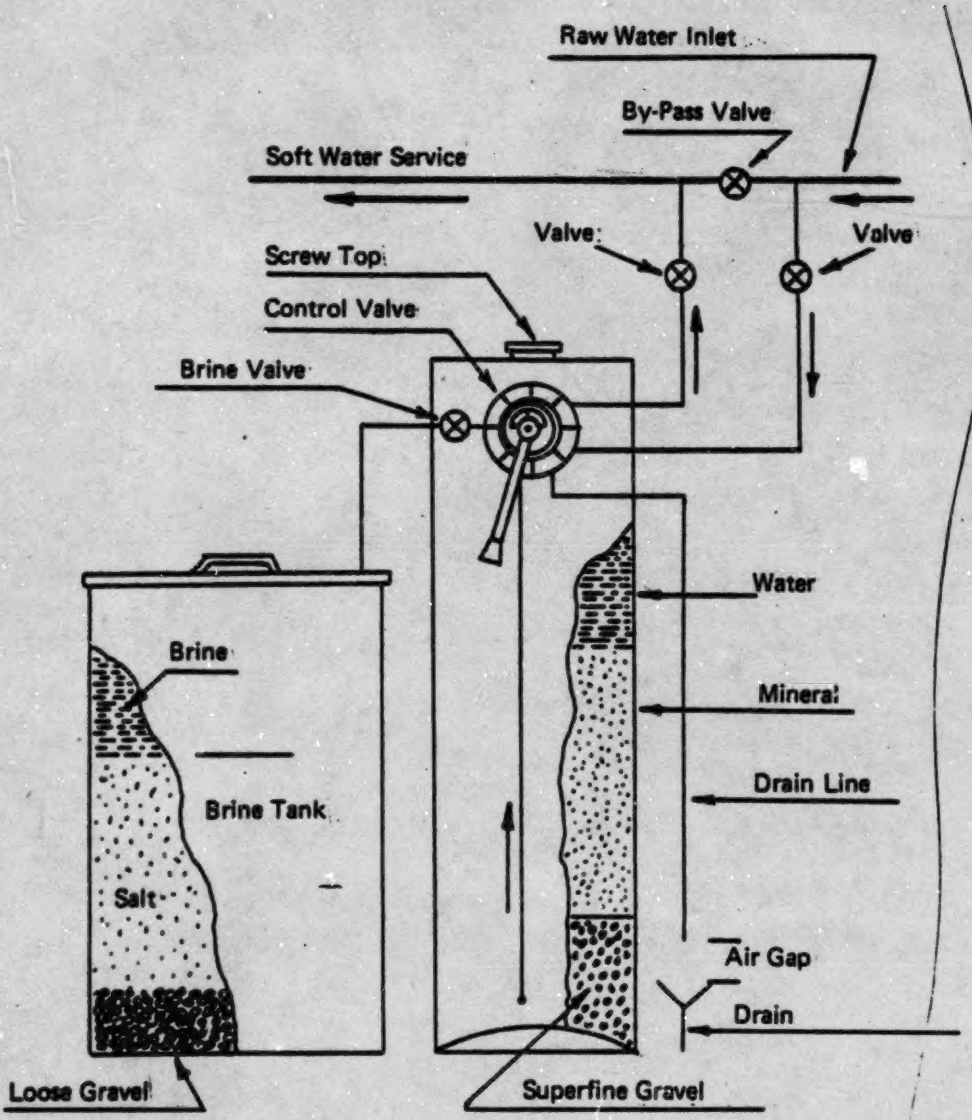
Pastuerizing type of disinfecting unit. Untreated water enters heat exchanger A where it is partially heated by water that has already been processed. Untreated water is moved through the circulating pump to the heating chamber C where the temperature is raised to 161° F. The temperature is maintained as the water passes through the retention tube D. The treated water then passes through the solenoid valve back to the heat exchanger where most of its heat is given up before it reaches the treated-water storage.

Ultra-Violet Light Method Of Disinfecting Water


POLLUTED WATER
SOLENOID VALVE (CLOSED)
SOLENOID VALVE (OPEN POSITION)
PHOTOELECTRIC CELL (ELECTRIC EYE)
DISINFECTING CHAMBER
QUARTZ SLEEVE HOUSING ULTRA VIOLET LAMP
(a)
DISINFECTED WATER

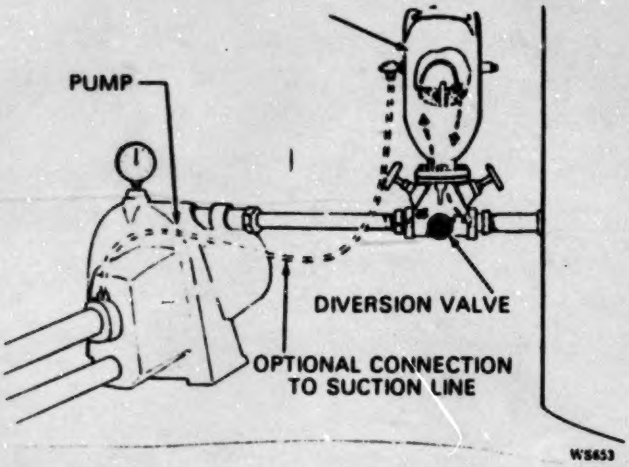
Types of automatic safety controls used for ultra-violet disinfection units. (a) Photo-electric cell holds the solenoid water valve open as long as the water passing through the disinfecting chamber is exposed to sufficient ultra-violet light. If dirt collects on the tube, or the tube breaks, or age limits the amount of light output, or there is a power outage, the photo-electric cell closes the solenoid valve (inset).

Manual-Type Softener

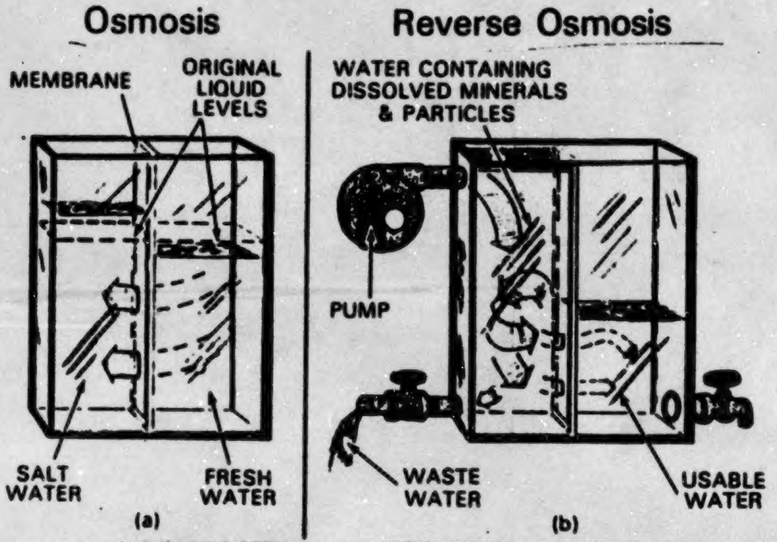

Raw Water Inlet
By-Pass Valve
Soft Water Service
Valve
Valve
Screw Top
Control Valve
Brine Valve
Water
Brine
Mineral
Drain Line
Brine Tank
Salt
Air Gap
Drain
Loose Gravel
Superfine Gravel

Means of Controlling Water Quality

Phosphate Feeder


PUMP
DIVERSION VALVE
OPTIONAL CONNECTION TO SUCTION LINE
WS653

Phosphate feeder installation. As shown, a portion of the water being delivered by the pump is directed through the feeder where it dissolves some of the phosphate material and returns to the water line.

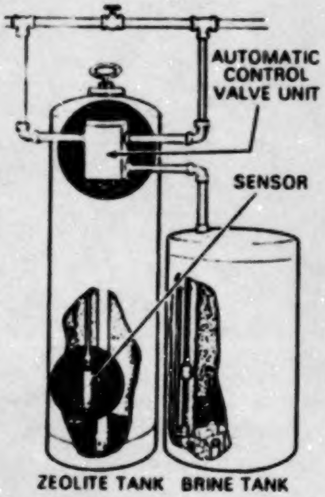

Osmosis
MEMBRANE
ORIGINAL LIQUID LEVELS
SALT WATER
FRESH WATER
(a)
Reverse Osmosis
WATER CONTAINING DISSOLVED MINERALS & PARTICLES
PUMP
WASTE WATER
USABLE WATER
(b)

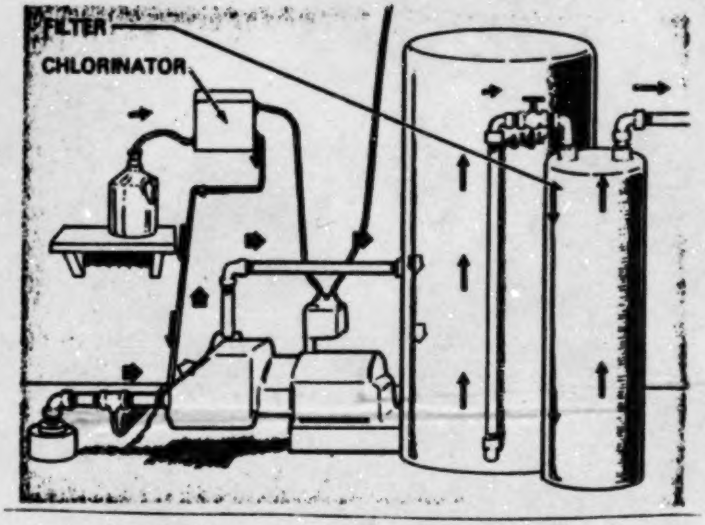
(a) Osmosis involves movement of freshwater through a membrane into the side containing solubles (saltwater). (b) Reverse osmosis involves applying pressure to the water on the side containing salt, hardness particles, etc. Water forced to move through the membrane in reverse to its normal movement, is cleansed of the soluble materials it contains.

Means Of Controlling Water Quality

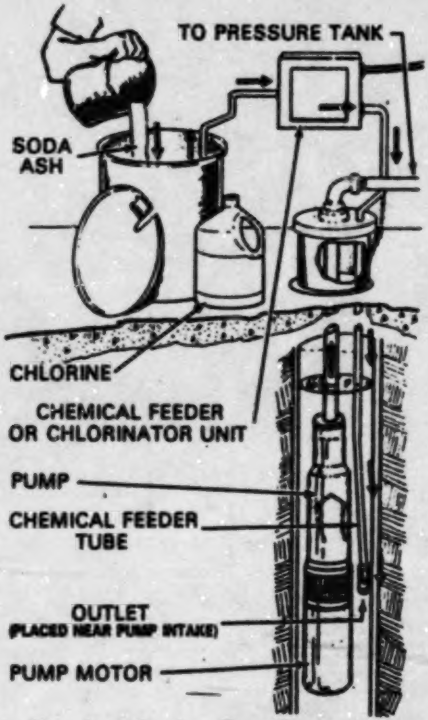
(Continued)

Ion-Exchange Units


AUTOMATIC CONTROL VALVE UNIT
SENSOR
ZEOLITE TANK
BRINE TANK


FILTER
CHLORINATOR

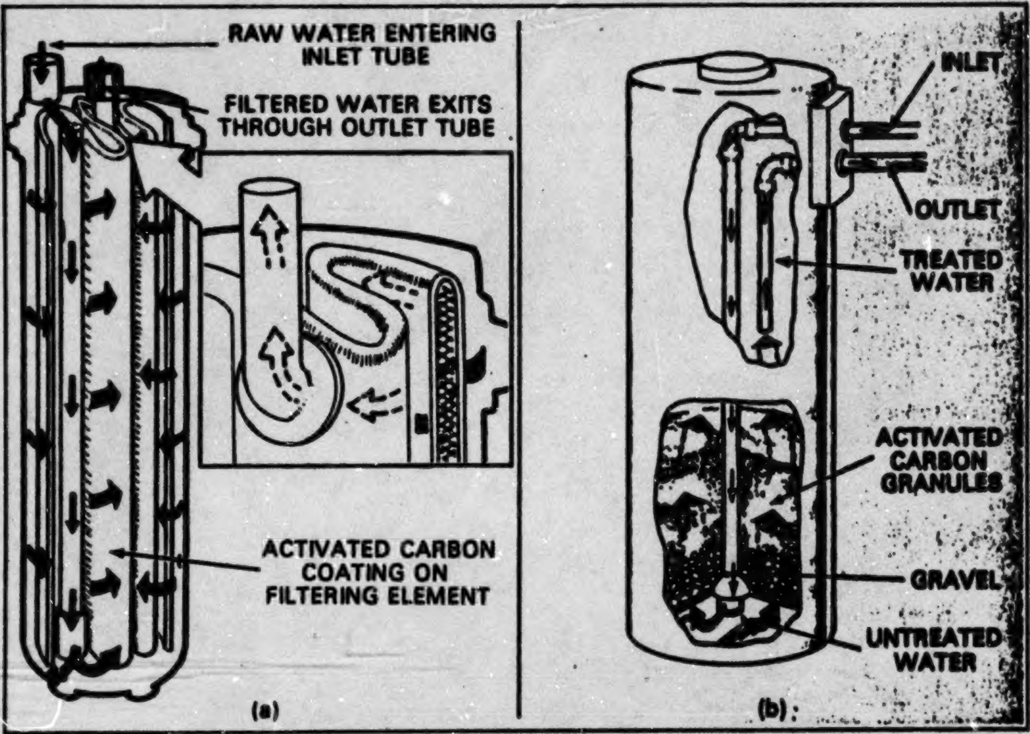
Chlorinator And Filter Units


TO PRESSURE TANK
SODA ASH
CHLORINE
CHEMICAL FEEDER OR CHLORINATOR UNIT
PUMP
CHEMICAL FEEDER TUBE
OUTLET (PLACED NEAR PUMP INTAKE)
PUMP MOTOR

Soda Ash Or Caustic Soda Feeder

Means Of Controlling Water Quality

(Continued)


RAW WATER ENTERING INLET TUBE
FILTERED WATER EXITS THROUGH OUTLET TUBE
ACTIVATED CARBON COATING ON FILTERING ELEMENT
(a)
INLET
OUTLET
TREATED WATER
ACTIVATED CARBON GRANULES
GRAVEL
UNTREATED WATER
(b)

Types of activated carbon filters. (a) Cartridge-type pre-coat filter consisting of an activated-carbon coating on a filter element. Water is filtered as it passes from the outside of the filter element into the inner area. (Inset) Filtered water inside the element is collected and discharged through a special outlet. (b) The bed-type unit consists of a tank with a bed of activated carbon granules in the bottom.

WATER TREATMENT
UNIT III

JOB SHEET #1--PREPARE A WATER SAMPLE FOR ANALYSIS BY A STATE TESTING LABORATORY

EVALUATION--Given access to a potable water supply, sample bottle, and cap and packaging material, prepare a water sample for analysis by state testing laboratory. The instructor will evaluate the procedure used and the general accuracy of the sampling.

I. Tools and equipment

   A. Three to five ounce bottle with cap

   B. Material to safely package bottle

   C. Source of cold running tap water

II. Procedure

   A. Select a cold water faucet

   B. Place bottle and cap in pan of cold water and raise the temperature of the water to boiling

      (NOTE: Boil water for ten minutes to sterilize the bottle.)

   C. Remove any hose or attachment on the water faucet if one is present

   D. Let water run full flow for about two minutes

   E. Reduce flow to about one-third of full flow

   F. Fill sterile bottle to within one-half inch of top

   G. Cap bottle tightly with sterile cap

   H. Package for mailing

   I. Mail or deliver sample immediately to the laboratory

   J. Check with instructor for approval of assignment

WATER TREATMENT
UNIT III

NAME ______________________________

TEST

1. Match the terms on the right to the correct descriptions or definitions.

______a. Water which is relatively free from harmful bacteria, viruses, parasites, and radiation

______b. A source which makes water unwholesome, impure, or undesirable for use or consumption

______c. Physical sources which contaminate water

______d. Correcting quality problems of water supply

______e. Weakening or destroying by chemical action

______f. Total amount of chlorine added to water in parts per million (ppm)

______g. Chlorine used up in reaction to organic matter

______h. Amount of chlorine solution which is left over after its killing action is "used up"

______i. The passage of fresh water through a special membrane into the side of a tank containing salt water

______j. By applying pressure to water on side containing salt or hardness particles, water is forced to move back through the membrane, cleansing it of the soluble materials it contains

______k. Individual or groups of atoms that carry an electrical charge

______l. The process of exchanging the hard calcium and magnesium ions for soft sodium ions

______m. Sand-like water softening material

1. Ion
2. Demand
3. Pollution
4. Zeolite
5. Safe water
6. Osmosis
7. Residual
8. Corrosive
9. Ion exchange
10. Water conditioning
11. Reverse osmosis
12. Dosage
13. Contamination

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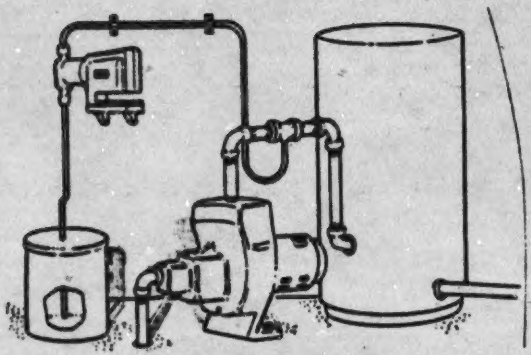
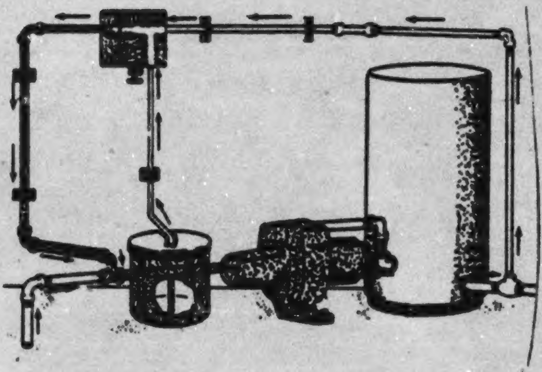
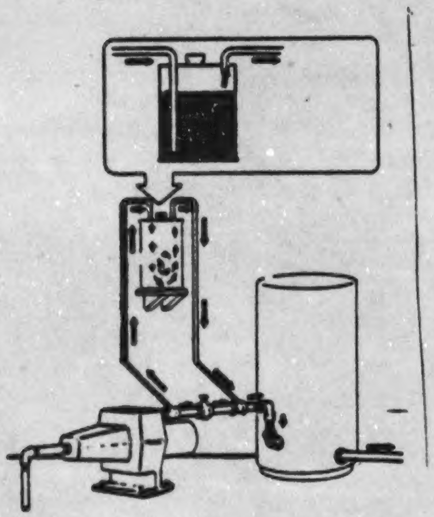
2. Identify five methods of disinfecting water.



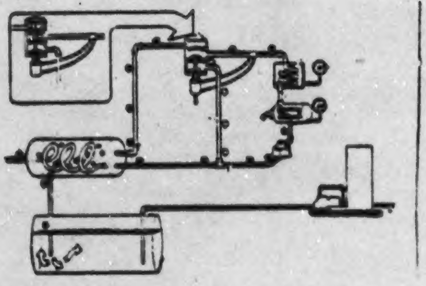
a. ______________________



b. ______________________



c. ______________________



d. ______________________

b. Red water

1) Symptoms

a) Red stains appear on clothes and porcelain plumbing fixtures

b) Causes corrosion of steel pipes

c) Water has metallic taste

d) Freshly-drawn water sometimes appears clear at first, but after exposure to air, rust particles form and settle to bottom of container

e) Red slime develops in toilet tanks

2) Probable cause

a)

b)

c. Brownish-black water

1) Symptoms

a) Fixtures stain brownish-black

b) Fabrics stain black

c) Coffee and tea have bitter taste

2) Probable cause

a)

b)

d. Acidity

1) Symptoms

a) "Eats away" copper and steel parts on pump, piping, tank and fixtures

b) If copper or brass are being "eaten," water may leave green stains on plumbing fixtures under a dripping faucet

c) If water contains iron, iron-removal methods are less effective

2) Probable cause

a)

b)

110-E

e. "Rotten egg" odor and flavor

- 1) Symptoms
  - a) "Eats away" copper and steel parts on pump, piping, tank and fixtures
  - b) If sulphur and iron are both present in water, finely-divided black particles may develop which is commonly called "black water"
  - c) Not satisfactory for cooking
- 2) Probable cause
  - a)
  - b)
  - c)

f. Other off flavors

- 1) Symptom--Water may taste bitter, brackish, oily, salty, or have a chlorine odor or taste
- 2) Probable cause
  - a)
  - b)
  - c)
  - d)

g. Turbidity

- 1) Symptom--Water with a dirty or muddy appearance
- 2) Probable cause
  - a)
  - b)
  - c)
  - d)

4. Match the conditions of water quality on the right to the means used to control them.

_____ a. 1) Water softener
    2) Reverse-osmosis unit
_____ b. 1) Phosphate feeder
    2) Ion-exchange units
    3) Oxidizing filters
    4) Chlorinator-and-filter units
_____ c. 1) Phosphate feeder
    2) Ion-exchange units
    3) Oxidizing filters
    4) Chlorinator and filter units
_____ d. Soda ash or caustic-soda feeder
_____ e. 1) Activated-carbon filter (cartridge type)
    2) Activated-carbon filter (carbon-bed type)
_____ f. 1) Open pond treatment
    2) Treatment systems
        a) Sedimentation and filtering system
        b) Diatomite filter
        c) Rapid sand filter

1. Iron
2. Acid water
3. Manganese
4. Hard water
5. Turbidity
6. Off-flavor

5. Demonstrate the ability to prepare a water sample for analysis by a state testing laboratory.
(NOTE: If this activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

WATER TREATMENT
UNIT III

ANSWERS TO TEST

1. a. 5
   b. 13
   c. 3
   d. 10
   e. 8
   f. 12
   g. 2
   h. 7
   i. 6
   j. 11
   k. 1
   l. 9
   m. 4

2. a. Pump chlorine method
   b. Injector chlorine method
   c. Tablet chlorine method
   d. Pastuerization method
   e. Ultra-violet light method

3. a. 2) Probable cause
      a) Calcium and magnesium in the water
      b) Iron
   b. 2) Probable cause
      a) Dissolved iron (sometimes including manganese)
      b) Iron bacteria
   c. 2) Probable cause
      a) Manganese is present usually along with iron
      b) Manganese bacteria
   d. 2) Probable cause
      a) Water contains carbon dioxide picked up from air, or from decaying vegetable matter which combines with water to form a weak acid

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b) In rare instances, water may contain mineral acid such as sulfuric, nitric, or hydrochloric acids

e. 2) Probable cause

- a) Hydrogen-sulfide gas
- b) Sulphate-reducing bacteria
- c) Sulphur bacteria

f. 2) Probable cause

- a) Extremely high mineral content
- b) Presence of organic matter
- c) Excess chlorine
- d) Water passage through areas containing salty or oily waste

g. 2) Probable cause

- a) Silt
- b) Sediment
- c) Small organisms
- d) Organic matter

4. a. 4

   b. 1 or 3

   c. 3 or 1

   d. 2

   e. 6

   f. 5

5. Evaluated to the satisfaction of the instructor

FUEL PIPING SYSTEMS
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with fuel piping systems to definitions or descriptions, identify materials used, select correct statements concerning system testing, and demonstrate the ability to size a residential gas piping system. This knowledge will be evidenced by correctly performing the procedures outlined on the assignment and job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with fuel piping systems to the correct definitions or descriptions.
2. Select materials for pipe and fittings and valves which are commonly used in fuel piping systems.
3. Distinguish between methods of joining fuel piping for different types of materials.
4. Select statements which are basic principles of most gas codes.
5. Select statements which correctly describe fuel piping testing methods.
6. Size a gas line.
7. Demonstrate the ability to perform leak tests on gas supply lines.

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FUEL PIPING SYSTEMS
UNIT IV

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information, assignment, and job sheets.

   C. Discuss unit and specific objectives.

   D. Discuss information and assignment sheets.

   E. Demonstrate and discuss the procedures outlined in the job sheet.

   F. Conduct a field trip to a construction site.

   G. Obtain a copy of the local fuel piping code.

   H. Have a local gas company representative visit the class.

   I. Demonstrate the use of local gas piping testing devices.

   J. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete job sheet.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Assignment Sheet #1--Size a Gas Line

   D. Answers to assignment sheet

   E. Job sheets #1--Perform Leak Tests on Gas Supply Lines

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G. Test

H. Answers to test

II. References:

A. *Uniform Plumbing Code.* Los Angeles: International Association of Plumbing and Mechanical Officials, 1973.

B. *Standard Gas Code.* Birmingham, Alabama: Southern Building Code Congress International, Inc. 1978.

C. *National Fuel Gas Code.* Arlington: American Gas Association. 1974.

D. *The BOCA Basic Mechanical Code.* Chicago: Building Officials and Code Administrator International, Inc. 1978.

FUEL PIPING SYSTEMS
UNIT IV

INFORMATION SHEET

I. Terms and definitions

   A. Natural gas–Gas as it comes from the earth, refined and piped directly to the consumer

   B. Manufactured gas–Gas usually made from petroleum and natural gas combinations

   C. L.P.G.–Liquified petroleum gas, a petroleum product

   D. Inert gas–Gas which has a low reaction to high pressures, high temperatures, flames or sparks

   E. Appliance fuel connector–An assembly of semi-rigid or flexible tubing and fittings to carry fuel between a fuel piping outlet and a fuel burning appliance

   F. A.S.T.M.--American Society for Testing and Materials

   G. Administrative authority--Local government board which administers gas code enforcement

   H. Ferrous–Metals having iron as their base such as steel and cast iron

   I. Nonferrous–Metals containing no iron, such as copper, brass, and aluminum

   J. B.T.U.--British thermal unit; the amount of heat needed to raise one cubic foot of water one degree F.

   K. C.F.H.–Cubic feet per hour

   L. A.G.A.–American Gas Association

II. Materials used in fuel piping systems

   (NOTE: All materials used for fuel piping systems must be clean and unused.)

   A. Pipe

      (NOTE: All pipe used for fuel gas must bear the manufacturer's name or trademark, pipe size, designation code, and A.S.T.M. specifications.)

      1. Wrought steel

         (NOTE: Wrought steel is commonly referred to as "black iron".)

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2. Copper tubing

   (NOTE: Type K or L is used only for L.P.G.)

3. Plastic

   a. P.E.--Polyethylene, Type III, II

   b. P.V.C.--Polyvinyl chloride, Type I, II

      (NOTE: P.E. and P.V.C. are used only underground.)

B. Fittings and valves

1. Wrought steel

   (NOTE: Wrought steel is commonly referred to as "black iron.")

2. Brass

3. Plastic

III. Methods of joining fuel piping

A. Black steel (schedule 40)

1. Threaded

2. Flanged

3. Welded

B. Copper--Flared

C. Plastic

1. Solvent welded

2. Heat fusion (welded)

3. Compression

4. Flanged

   (NOTE: Recommendations of the pipe manufacturer for joining and use of plastic pipe must be taken into consideration.)

INFORMATION SHEET

IV. **Basic principles of natural gas codes**

(NOTE: Refer to local codes.)

A. All joints in the piping system, unless welded, shall be screwed joints, having approved standard threads

(NOTE: Such screwed joints shall be made up with approved pipe joint material, insoluble in the presence of fuel gas and applied to the male threads only.)

B. No gas piping shall be installed in or on the ground under any building or structure, and all exposed gas piping shall be kept at least six (6) inches above grade or structure

(NOTE: When necessary due to structure conditions, approved type gas piping may be installed in other locations when permission has first been obtained from the administrative authority.)

C. Where water vapor is present in the fuel gas served, accessible drip pipes shall be provided at points where condensation will tend to collect (Figure 1)

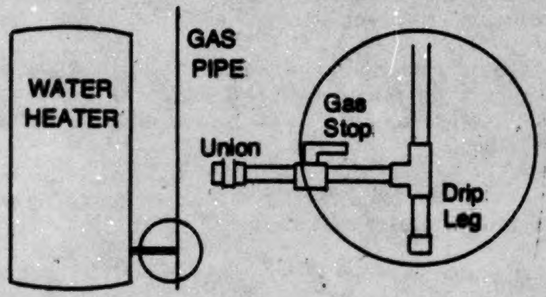

FIGURE 1

D. Ferrous gas piping installed underground in exterior locations shall be protected from corrosion by approved coatings or wrapping materials and all such horizontal piping shall have at least 12 inches of earth cover or other equivalent protection

(NOTE: Risers shall be wrapped to a point at least 6 inches above grade.)

E. All gas pipe protective coatings shall be approved types, machine applied, and conform to recognized standards

F. Field wrapping shall provide equivalent protection and is restricted to those short sections and fittings necessarily stripped for threading or welding

G. Zinc coatings (galvanizing) shall not be deemed adequate protection for piping below ground

H. Ferrous metals in exposed exterior locations shall be protected from corrosion in a manner satisfactory to the administrative authority

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INFORMATION SHEET

I. All gas piping shall be adequately supported by metal straps or hooks at intervals not to exceed those shown in Table I

TABLE 1

Support of Piping

Size of Pipe (inches)	Feet
½"	6
¾" or 1"	8
1¼" or larger (Horizontal)	10
1¼" or larger (Vertical)	Every floor level

J. Gas piping installed below grade shall be effectively supported at all points on undisturbed or well compacted soil

K. Material used for backfill around the pipe shall be free of rocks, building materials, ashes, and trash

L. Gas piping supplying more than one building on any one premise shall be equipped with separate shutoff valves to each building, so arranged that the gas supply can be turned on or off to any individual or separate building

M. Such shutoff valve shall be located outside the building it supplies and shall be readily accessible at all times

N. Where unions are necessary, right and left nipples and couplings shall be used

O. Ground-joint unions may be used at exposed fixture, appliance, or equipment connections, and in exposed exterior locations immediately on the discharge side of a building shutoff valve

(NOTE: Heavy duty flanged type unions may be used in special cases when first appoved by the administrative authority.)

P. Bushings shall not be used

Q. Valves used in connection with gas piping shall be approved types

R. An accessible shutoff valve shall be installed in the fuel supply piping outside of each appliance and ahead of the union connection thereto, and in addition to any valve on the appliance

(NOTE: Shutoff valves shall be within 3 feet of the appliance.)

S. Shutoff valves may be located immediately adjacent to and inside or under an appliance when placed in an accessible and protected location and when such appliance may be removed without removal of the valve

INFORMATION SHEET

T. Shutoff valves may be accessibly located inside wall heaters and wall furnaces listed for recessed installation where necessary maintenance can be performed without removal of the shutoff valve

U. Appliance connections shall at no time have a diameter less than that of the inlet connection to the appliance as provided by the manufacturer

V. A gas appliance may be connected with an approved listed metal appliance connector under the following conditions:

1. Listed metal appliance connectors shall have an overall length not to exceed 3 ft.

   (NOTE: A range connector may exceed 3 ft., but not exceed 6 ft.)

2. No part of such connector shall be concealed within or extended through any wall, floor, or partition

3. A listed accessible appliance connector valve, not less than the nominal size of the connector, shall be provided at the gas piping outlet immediately ahead of the connector

4. All connectors shall be of such size as to provide the total demand of the connected appliance

5. Aluminum alloy connectors may be used only in interior locations where they shall not be in contact with masonry, plaster or insulation, or are not subject to repeated corrosive wettings

V. Fuel piping testing methods

A. Applying pressure

1. The system should be filled with air or inert gas

   (NOTE: Never use pure oxygen because it becomes explosive when in contact with oil or grease.)

2. Gas piping should withstand a pressure of at least 6 inches of mercury measured with a manometer for a period of not less than 10 minutes without showing a drop in pressure

   (NOTE: High pressure piping requires 10 inches of mercury and all piping should be tested at no less than twice the maximum pressure to which the piping will be subjected in operation.)

INFORMATION SHEET

B. Checking for leaks

1. Leaks can be located by applying soap and water to the piping joints
2. Fire or acid should not be used to locate leaks
3. Water should not be introduced into the piping system for any purpose

VI. Sizing fuel pipe for residential construction

(NOTE: To determine the size of each section of pipe in any system within the range of Table #3, proceed as follows:)

A. From Table 2, determine cubic feet of gas to be consumed for each outlet

(NOTE: 1100 B.T.U. per cubic ft. is the standard of measurement used in sizing fuel pipes.)

TABLE 2
Minimum Demand of Typical Gas Appliances
In BTU Per Hour

Appliance	Demand In BTU
Domestic Gas Range	65,000
Domestic recessed top burner section	40,000
Domestic recessed oven section	25,000
Storage Water Heater - up to 30-gal. tank	30,000
Storage Water Heater - 40 to 50-gal. tank	50,000
Domestic Clothes Dryer	35,000
Fireplace Log Lighter (Residential)	25,000
Fireplace Log Lighter (Commercial)	50,000
Barbecue (Residential)	50,000
Gas Refrigerator	3,000
Bunsen Burner	3,000
Gas Engines (per horsepower)	10,000
Steam Boilers (per horsepower)	50,000

INFORMATION SHEET

B. Measure the length of the pipe from the gas meter location to the most remote outlet on the system

1. In Table 3, select the column showing that distance or the next longer distance if the table does not give the exact length

TABLE 3
Size of Gas Piping

Maximum delivery capacity in cubic feet of gas per hour (CFH)
of I.P.S. pipe carrying natural gas of 0.65 specific gravity
Based on pressure drop 0.5 inch water column
LENGTH IN FEET

Pipe Size	10'	20'	30'	40'	50'	60'	70'	80'	90'	100'	125'
½	170	118	95	80	71	64	60	55	52	49	44
¾	360	245	198	169	150	135	123	115	108	102	92
1	670	430	370	318	282	255	235	220	205	192	172
1¼	1,320	930	740	640	565	510	470	440	410	390	345
1½	1.990	1,370	1.100	950	830	760	700	650	610	570	510
2	3.880	2.680	2.150	1.840	1.610	1.480	1.350	1.250	1.180	1.100	1.000
2½	6.200	4,120	3.420	2.950	2.600	2.360	2.180	2.000	1.900	1.800	1.600
3	10.900	7.500	6.000	5.150	4.600	4,150	3.820	3.550	3.300	3,120	2.810
3½	16.000	11,000	8.900	7.600	6.750	6.200	5.650	5.250	4.950	4.650	4,150
4	22.500	15.500	12,400	10.600	9.300	8.500	7.900	7.300	6.800	6,400	5,700

	150'	200'	250'	300'	350'	400'	450'	500'	550'	600'
½	40	34	30	27	25	23	22	21	20	19
¾	83	71	63	57	52	48	45	43	41	39
1	158	132	118	108	100	92	86	81	77	74
1¼	315	270	238	215	200	185	172	162	155	150
1½	460	400	350	320	295	275	255	240	230	220
2	910	780	690	625	570	535	500	470	450	430
2½	1,450	1,230	1,100	1,000	920	850	800	760	720	690
3	2.550	2,180	1.930	1.750	1.600	1.500	1,400	1,320	1,250	1,200
3½	3.800	3.200	2.860	2.600	2.400	2.200	2,100	2,000	1,900	1,800
4	5,200	4,400	3.950	3,600	3,250	3,050	2,850	2,700	2,570	2,450

2. Starting at the most remote outlet, find in the vertical column just selected the gas demand for that outlet

   (NOTE: If the exact figure of demand is not shown, choose the next larger figure below in the column.)

3. Opposite this demand figure, in the first column at the left in Table #3, will be found the correct size of pipe

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INFORMATION SHEET

4. Using this same vertical column, proceed in a similar manner for each section of pipe serving this outlet

   a. For each section of pipe, determine the total gas demand supplied by that section

   b. Opposite this demand figure, in the first column at the left in Table #3, will be found the correct size of pipe

5. Size each section of branch piping not previously sized by measuring the distance from the gas meter location to the most removed outlet in that branch and follow the procedures of steps 1, 2, 3, and 4 above

Example: Determine the required pipe size of each section and outlet of a piping system by following the following steps and referring to Figure 1

(NOTE: Gas to be used has 1100 B.T.U. per cubic ft. and all other considerations are normal.)

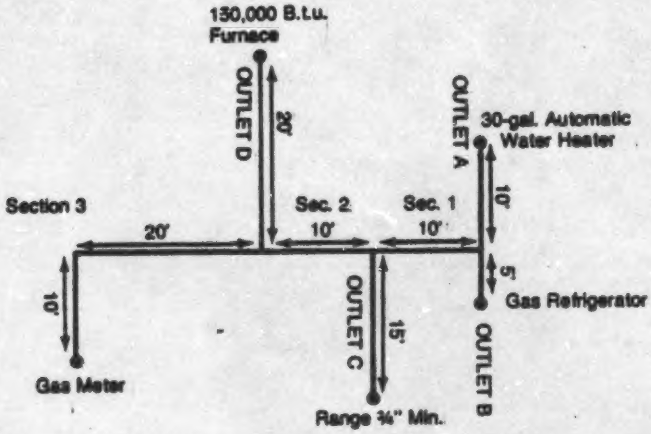
130,000 B.t.u.
Furnace
OUTLET D
20'
OUTLET A
30-gal. Automatic Water Heater
Section 3
Sec. 2
Sec. 1
20'
10'
10'
10'
5'
Gas Refrigerator
10'
OUTLET C
15'
OUTLET B
Gas Meter
Range ¾" Min.

Figure 1

I. From Table 2, determine cubic feet of gas to be consumed for each outlet

(NOTE: Gas to be used has 1100 B.T.U. per cubic ft.)

A. Maximum gas demand of outlet A = 27 cu. ft. per hour

B. Maximum gas demand of outlet B = 3 cu. ft. per hour

INFORMATION SHEET

C. Maximum gas demand of outlet C = 59 cu. ft. per hour

D. Maximum gas demand of outlet D = 136 cu. ft. per hour

(NOTE: Divide 150,000 B.T.U. per hour by 1100.)

II. Measure the length of the pipe from the gas meter location to the most remote outlet on the system

(NOTE: The length of pipe from the gas meter to the most remote outlet, Outlet A, is 60 feet.)

A. In Table #3, select the column showing that distance or the next longer distance if the table does not give the exact length

B. Starting at the most remote outlet, find in the vertical column just selected the gas demand for that outlet

(NOTE: If the exact figure of this demand is not shown, choose the next larger figure below in the column.)

C. Opposite this demand figure, in the first column at the left in Table #3, will be found the correct size of pipe; outlet A, supplying 27 c.f.h., requires 1/2" pipe

D. Using this same vertical column, proceed in a similar manner for each section of pipe serving this outlet

1. For each section of pipe determine the total gas demand supplied by that section
2. Opposite this demand figure, in the first column at the left in Table #3, will be found the correct size of pipe
   a. Section 1, supplying outlets A and B, or 30 c.f.h. requires 1/2" pipe
   b. Section 2, supplying outlets A, B, and C, or 89 c.f.h., requires 3/4" pipe
   c. Section 3, supplying outlets A, B, C, and D, or 225 c.f.h., requires one inch-pipe

E. Size each section of branch piping not previously sized by measuring the distance from the gas meter locaton to the most removed outlet in that branch and follow the procedures of steps A, B, C and D above

1. Outlet B, supplying 3 c.f.h., requires 1/2" pipe
2. Outlet C, supplying 59 c.f.h., requires 3/4" pipe, because range connections are 3/4"

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INFORMATION SHEET

3. Outlet D, supplying 136 c.f.h., requires 3/4 inch pipe

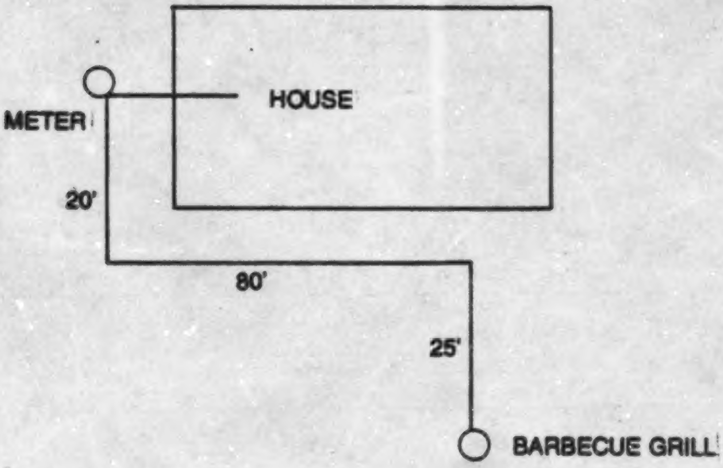
   (NOTE: Use column marked 50' in Table #3.)

FUEL PIPING SYSTEMS
UNIT IV

ASSIGNMENT SHEET #1--SIZE A GAS LINE

Directions: Size the gas line from the meter to the outdoor barbecue grill by using the tables below.

FIGURE 1



a. Maximum gas demand for barbecue grill (from Table 1) ____________________

b. Total distance of gas piping (from Figure 1) ____________________

TABLE 1
Minimum Demand of Typical Gas Appliances
in BTU Per Hour

Appliance	Demand in BTU
Domestic Gas Range	65,000
Domestic recessed top burner section	40,000
Domestic recessed oven section	25,000
Storage Water Heater - up to 30-gal. tank	30,000
Storage Water Heater - 40 to 50-gal. tank	50,000
Domestic Clothes Dryer	35,000
Fireplace Log Lighter (Residential)	25,000
Fireplace Log Lighter (Commercial)	50,000
Barbecue (Residential)	50,000
Gas Refrigerator	3,000
Bunsen Burner	3,000
Gas Engines (per horsepower)	10,000
Steam Boilers (per horsepower)	50,000

c. Size of gas piping (Table 2) ______________

TABLE 2
Size of Gas Piping
Maximum delivery capacity in cubic feet of gas per hour (CFH)
of I.P.S. pipe carrying natural gas of 0.65 specific gravity
Based on pressure drop 0.5 inch water column
LENGTH IN FEET

Pipe Size	10'	20'	30'	40'	50'	60'	70'	80'	90'	100'	125'
½	170	118	95	80	71	64	60	55	52	49	44
¾	360	245	198	169	150	135	123	115	108	102	92
1	670	430	370	318	282	255	235	220	205	192	172
1¼	1,320	930	740	640	565	510	470	440	410	390	345
1½	1,990	1,370	1,100	950	830	760	700	650	610	570	510
2	3,880	2,650	2,150	1,840	1,610	1,480	1,350	1,250	1,180	1,100	1,000
2½	6,200	4,120	3,420	2,950	2,600	2,360	2,180	2,000	1,900	1,800	1,600
3	10,800	7,500	6,000	5,150	4,600	4,150	3,820	3,550	3,300	3,120	2,810
3½	16,000	11,000	8,900	7,600	6,750	6,200	5,650	5,250	4,950	4,680	4,150
4	22,900	15,500	12,400	10,600	9,300	8,500	7,900	7,300	6,800	6,400	5,700

Pipe Size	150'	200'	250'	300'	350'	400'	450'	500'	550'	600'
½	40	34	30	27	25	23	22	21	20	19
¾	83	71	63	57	52	48	45	43	41	39
1	155	132	118	108	100	92	86	81	77	74
1¼	315	270	238	215	200	185	172	162	155	150
1½	460	400	360	320	295	275	255	240	230	220
2	910	780	690	625	570	535	500	470	450	430
2½	1,450	1,230	1,100	1,000	920	850	800	760	720	690
3	2,580	2,180	1,930	1,750	1,600	1,500	1,400	1,320	1,250	1,200
3½	3,800	3,200	2,860	2,600	2,400	2,200	2,100	2,000	1,900	1,800
4	5,200	4,400	3,950	3,600	3,250	3,050	2,850	2,700	2,570	2,450

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FUEL PIPING SYSTEMS
UNIT IV

ANSWERS TO ASSIGNMENT SHEET #1

Pipe size = 3/4"

Method used to solve assignment:

A. Maximum gas demand for barbecue grill (from Table 2) = 50,000 B.T.U.

$$\begin{array}{r} 45.4 \\ 1100\overline{)50000} \end{array} = 45 \text{ c.f.h.}$$

B. Total distance of gas piping = 125' (Figure 1, assignment sheet.)

C. From column showing 125' (Table 2), 45 c.f.h. is larger than 44, so the next larger size is used

D. Pipe size for barbecue is 3/4"

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FUEL PIPING SYSTEMS
UNIT IV

JOB SHEET #1--PERFORM LEAK TESTS ON GAS SUPPLY LINES

EVALUATION--Given access to tools, equipment, and materials, perform a leak test on a gas supply line. Evaluation will include correct methods used, safety precautions used, and use of correct tools.

I. Tools and equipment
   A. Air compressor
   B. Pressure gauge and pipe fittings
   C. Pipe wrenches
   D. Pipe joint compound

II. Procedure
   A. Cap all gas risers
   B. Connect air compressor to line
   C. Run air compressor until desired pressure has been reached

      (NOTE: Do not pump against the meter or it will be damaged.)
   D. Check for a drop in pressure
   E. Check with instructor for evaluation of job
   F. Clean up area and return all tools and equipment

FUEL PIPING SYSTEMS
UNIT IV

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Gas as it comes from the earth, refined and piped directly to the consumer

_____b. Gas usually made from petroleum and natural gas combinations

_____c. Liquified petroleum gas, a petroleum product

_____d. Gas which has a low reaction to high pressures, high temperatures, flames or sparks

_____e. An assembly of semi-rigid or flexible tubing and fittings to carry fuel between a fuel piping outlet and a fuel burning appliance

_____f. American Society for Testing and Materials

_____g. Local government board which administers gas code enforcement

_____h. Metals having iron as their base such as steel and cast iron

_____i. Metals containing no iron such as copper, brass, and aluminum

_____j. British thermal unit; the amount of heat needed to raise one cubic foot of water one degree F.

_____k. Cubic feet per hour

_____l. American Gas Association

1. Nonferrous
2. Appliance fuel connector
3. Administrative authority
4. A.S.T.M.
5. Manufactured gas
6. Natural gas
7. L.P.G.
8. Ferrous
9. Inert gas
10. A.G.A.
11. B.T.U.
12. C.F.H.

2. Select materials for pipe and fittings and valves which are commonly used in fuel piping systems by placing an "X" in the appropriate blanks.

_____a. Cast iron

_____b. Wrought steel

_____c. Vitreous clay

______d. Copper

______e. Plastic

______f. Brass

______g. Galvanized steel

3. Distinguish between methods of joining fuel piping for different types of materials by placing a "B" next to methods used for black steel, "C" next to methods used for copper, and a "P" next to methods used for plastic.

______a. Flanged

______b. Heat fusion (welded)

______c. Flared

______d. Threaded

______e. Solvent welded

______f. Welded

______g. Compression

4. Select statements which are basic principles of most gas codes by placing an "X" in the appropriate blanks.

______a. All joints in the piping system, unless welded, shall be screwed joints, having approved standard threads

______b. Zinc coatings (galvanizing) is considered adequate protection for piping below ground

______c. Gas piping supplying more than one building on any one premise shall be equipped with separate shutoff valves to each building, so arranged that the gas supply can be turned on or off to any individual or separate building

______d. Bushings may be used in concealed locations

______e. Gas piping may be installed in or on the ground under any building

______f. Where water vapor is present in the fuel gas served, pipes may be wrapped to help disburse water —

______g. Ferrous gas piping installed underground in exterior locations shall be protected from corrosion by approved coatings or wrapping materials and all such horizontal piping shall have at least 12 inches of earth cover or other equivalent

______h. All gas pipe protective coatings shall be approved types, machine applied, and conform to recognized standards

_____ i. Material used for backfill around the pipe shall be free of rocks, building materials, ashes, and trash

_____ j. Appliance connections shall at no time have a diameter less than that of the inlet connection to the appliance as provided by the manufacturer

5. Select statements which correctly describe fuel piping testing methods by placing an " X" in the appropriate blanks.

_____ a. When applying pressure, the system should be filled with air or inert gas

_____ b. Gas piping should withstand a pressure of at least 6 inches of mercury measured with a manometer for a period of not less than 10 minutes without showing a drop in pressure

_____ c. Leaks can be located by applying acid to the piping joints

_____ d. Water can be introduced into the piping system when it will not freeze

_____ e. High pressure pipes should be heated by a blow torch before testing is begun

6. Size a gas line.

7. Demonstrate the ability to perform leak tests on gas supply lines.

(NOTE: If this activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

FUEL PIPING SYSTEMS
UNIT IV

ANSWERS TO TEST

1. a. 6
   b. 5
   c. 7
   d. 9
   e. 2
   f. 4
   g. 3
   h. 8
   i. 1
   j. 11
   k. 12
   l. 10
2. b, d, e, f
3. a. B, P
   b. P
   c. C
   d. B
   e. P
   f. B
   g. P
4. a, c, g, h, i, j
5. a, b
6. Evaluated to the satisfaction of the instructor
7. Performance skills evaluated to the satisfaction of the instructor

AUXILIARY SYSTEMS
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with auxiliary systems to correct definitions or descriptions, identify components and select functions of a residential spa, and a lawn sprinkler system. This knowledge will be evidenced by correctly performing the procedures outlined on the job sheet and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with auxiliary systems to the correct definitions or descriptions.
2. Select true statements concerning functions of a residential spa.
3. Identify components of a residential spa.
4. Discuss four items to be considered in designing a sprinkler system.
5. List three items to be considered in developing a layout for a sprinkler system.
6. Name three items used to excavate trenches for sprinkler systems.
7. Select the types of pipe most commonly used for sprinkler systems.
8. Select the types of fittings and methods of joining most commonly used for sprinkler systems.
9. State the purpose of drain valves in a sprinkler system.
10. List three sources of water for a residential sprinkler system.
11. Identify three types of sprinkler heads.
12. List four sources of pressure allowance due to friction loss.
13. Select correct methods used to minimize pressure drop.
14. Demonstrate the ability to install a lawn sprinkler system.

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AUXILIARY SYSTEMS
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet

   B. Provide student with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss the procedures outlined in the job sheets.

   G. Visit a job site to see the installation of a spa and/or sprinkler system.

   H. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete job sheet.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Components of a Spa

      2. TM 2--Sprinkler Systems

      3. TM 3--Trenching

      4. TM 4--Piping System

      5. TM 5--Sprinkler Heads

D. Job Sheet #1--Install A Lawn Sprinkler System

E. Test

F. Answers to test

II. References--Blankenbaker, E. Keith. *Modern Plumbing*. South Holland, IL: Goodheart-Willcox, 1978.

AUXILIARY SYSTEMS
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Spa--Residential pool larger than a bathtub, but smaller than a swimming pool, intended as a hydro-massage with water and/or air jets which circulate the water

(NOTE: Water temperature should be a maximum of 105°F.)

B. Sprinkler system--Piping arrangement designed to spray irrigation water on lawns, gardens, or other areas

C. Sprinkler head--Device used to spray or disperse water in an evenly distributed pattern

D. Skimmer--Device attached to spa which draws surface water off and directs it to the filter

E. Filter--Device in circulating pipe line which extracts minute solid materials from the bathing water

F. Air injector--Device designed to allow air into the water circulating system to help provide turbulence and a massaging effect

II. Functions of a residential spa

A. Provides private bathing for one or more persons

B. Provides either indoor or outdoor bathing

C. Provides heated water in a multi-person bath

D. Provides aerated water in the multi-person bath

E. Provides a turbulent action for a water massage

(NOTE: A water massage is hydrotherapy for convalescents.)

F. Provides privacy for a social function centered about activites in a bath

(NOTE: All electrical switches, timers, and control devices should be located a safe distance from the spa.)

III. Components of a residential spa (Transparency 1)

A. Tub or spa

B. Pump

C. Heater

INFORMATION SHEET

D. Filter

E. Spa light

F. Skimmer

G. Air injector

H. Piping

I. Fittings and valves

J. Whirlpool jet inlet

IV. Sprinkler system design (Transparency 2)

(NOTE: Sprinkler systems are usually governed by local plumbing codes.)

A. Design must provide for controlled coverage of the area to be watered

B. Sprinkler system must make the most of existing water pressure

(NOTE: Vacuum breakers must be installed 6" above grade or heads.)

C. Cost of the sprinkler system should include maintenance and repair

D. In cold climates, the system must be designed to prevent freeze damage

V. Developing a layout for a sprinkler system

(NOTE: The layout for a sprinkler system is developed from the designer's plot plan.)

A. Location of the water sources

B. Location of the controls

C. Layout of the sprinkler heads

VI. Items used to excavate trenches for sprinkler systems (Transparency 3)

A. Hand shovel

B. Power trencher

C. Power pipe layer

VII. Types of pipe most commonly used for sprinkler systems

A. P.E. (polyethylene)

B. P.V.C. (polyvinylchloride)

INFORMATION SHEET

VIII. Types of fittings used for sprinkler systems and methods of joining (Transparency 4)

- A. P.E. by the compression method
- B. P.V.C. by joining with solvent cement

IX. Purpose of drain valves in a sprinkler system (Transparency 4)--Drain valves are installed in all low points of piping to prevent piping from freezing

(NOTE: Automatic valves provide automatic drainage to prevent freezing. Hand operated valves must be opened before freezing weather sets in.)

X. Sources of water for a residential sprinkler system (Transparency 4)

(CAUTION: Vacuum breakers must be installed.)

- A. Existing hose bibs
- B. Cutting into main water system

  (NOTE: Correct pipe sizing may necessitate cutting into the largest water pipe in the residence.)
- C. Adding separate line direct from city water main

XI. Types of sprinkler heads (Transparency 5)

- A. Spray type
- B. Rotary type
- C. Wave type (oscillating)

XII. Sources of pressure allowance due to friction loss

- A. Diameter of pipe
- B. Length of pipe
- C. Number of fittings
- D. Type of fittings used

XIII. Methods used to minimize pressure drop

- A. Keep pipe runs as short as possible
- B. Keep fittings to a minimum

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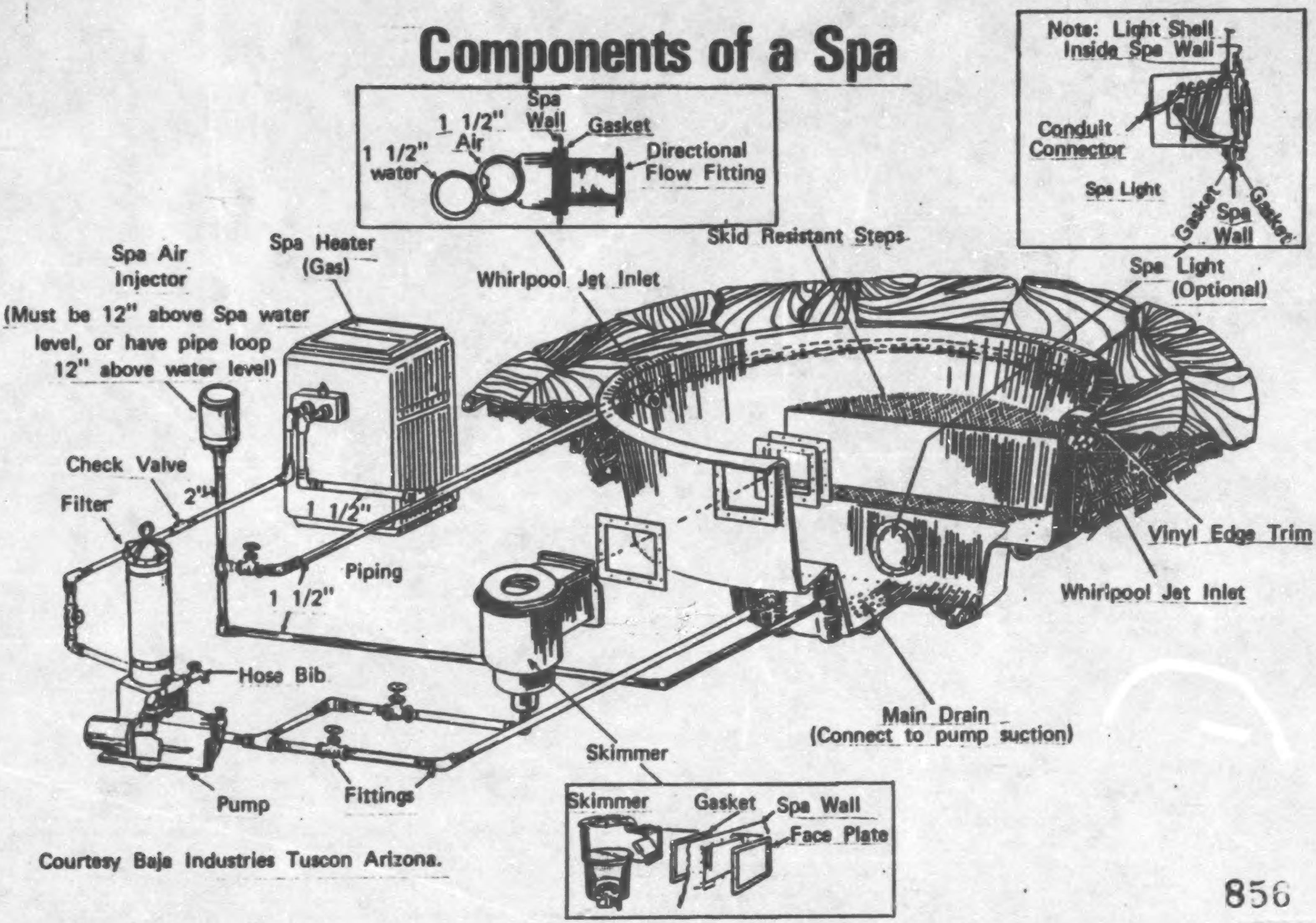
INFORMATION SHEET

C. Divide system into several units which sprinkle at different times

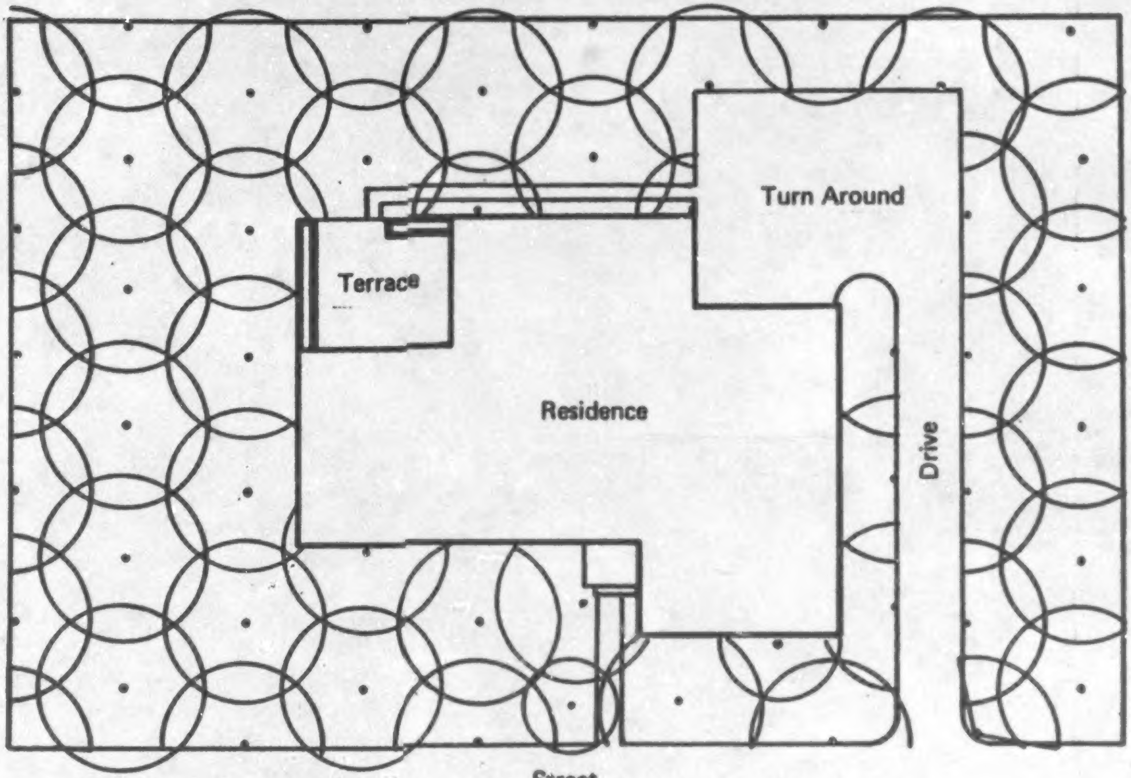
(NOTE: This method is often used when the system will require more water flow than can be delivered by the normal water supply piping in a residential structure.)

Components of a Spa


1 1/2" Air
Spa Wall
Gasket
1 1/2" water
Directional Flow Fitting
Note: Light Shell Inside Spa Wall
Conduit Connector
Spa Light
Gasket
Spa Wall
Gasket
Spa Air Injector
(Must be 12" above Spa water level, or have pipe loop 12" above water level)
Spa Heater (Gas)
Whirlpool Jet Inlet
Skid Resistant Steps
Spa Light (Optional)
Check Valve
2"
Filter
1 1/2"
Piping
1 1/2"
Vinyl Edge Trim
Whirlpool Jet Inlet
Hose Bib
Main Drain (Connect to pump suction)
Skimmer
Pump
Fittings
Skimmer
Gasket
Spa Wall
Face Plate

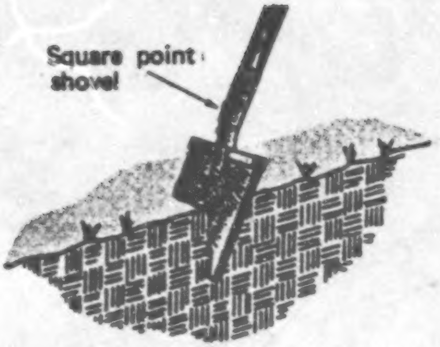
Courtesy Baja Industries Tuscon Arizona.

Sprinkler Systems

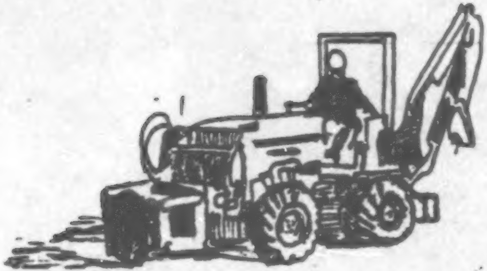

Turn Around
Terrace
Residence
Drive
Street

Using a plot plan, the designer will place sprinkler heads so that all lawn or garden areas are adequately watered.

Trenching

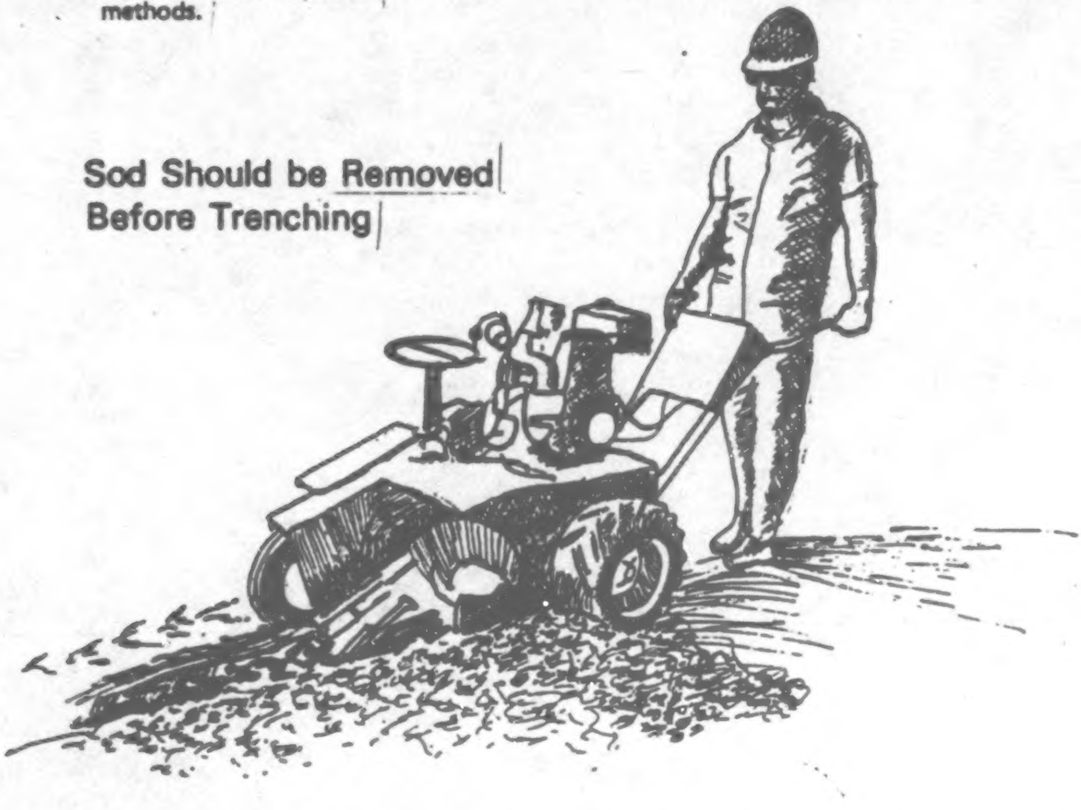


Trenching with a shovel. This method has largely been replaced by faster methods.



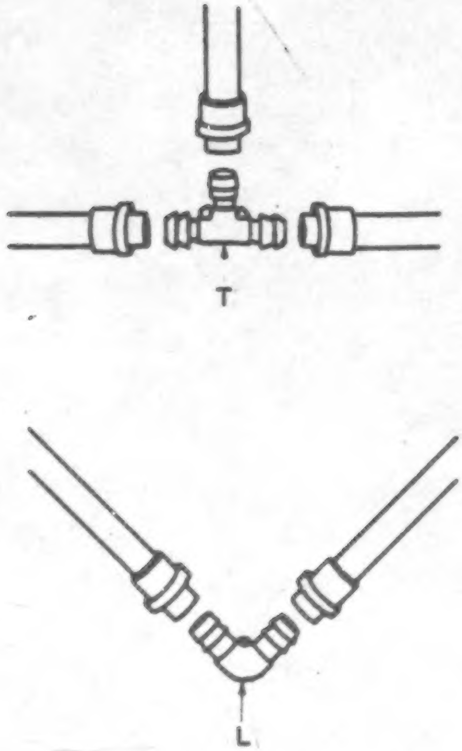
The automatic pipe laying machine cuts through the ground and buries the pipe all in a single operation.

Sod Should be Removed Before Trenching

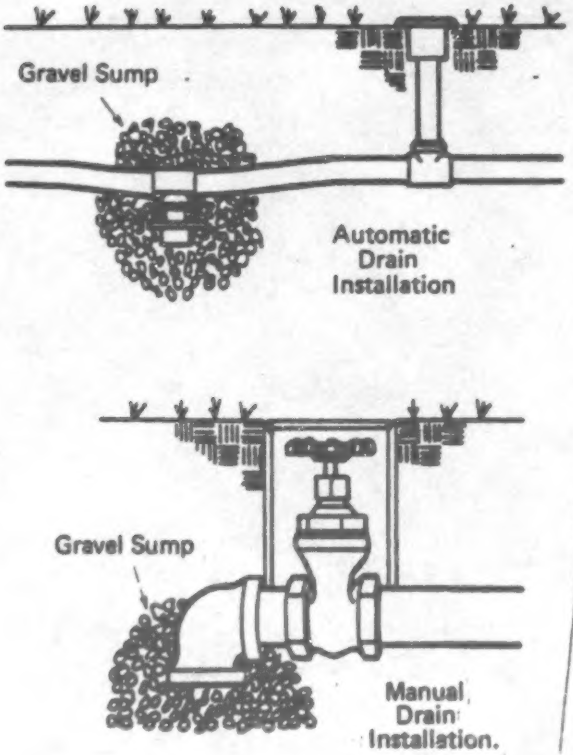


The trencher cuts a narrow ditch and places the excavated earth alongside the trench.

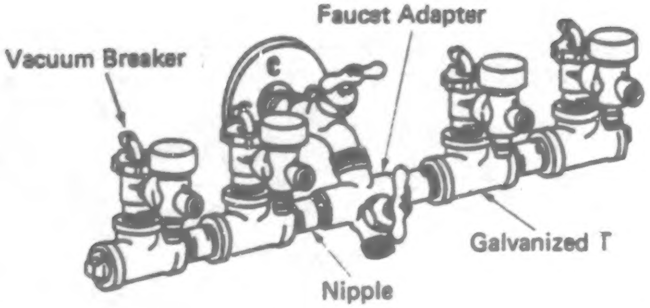
Piping System



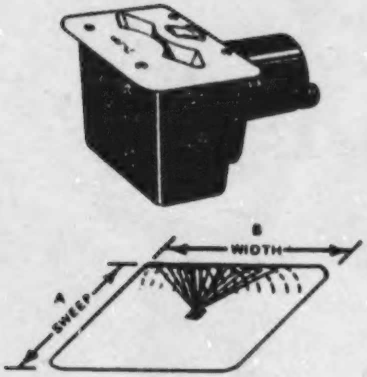
Compression type fittings are used to connect polyethylene pipe and fittings


Gravel Sump
Automatic Drain Installation
Gravel Sump
Manual Drain Installation.

Drain valves are installed to remove water from the piping sustem and prevent freeze damage..

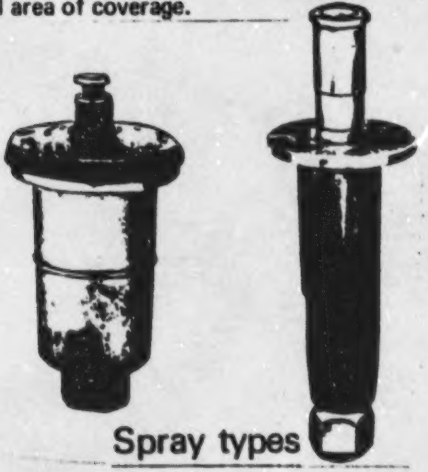

Faucet Adapter
Vacuum Breaker
Galvanized T
Nipple

Sprinkler Heads



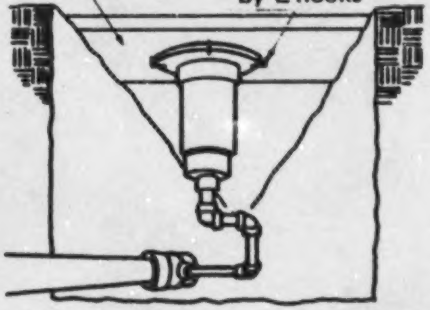
Wave type

Wave sprinkler head distributes water over rectangular area. Sweep times width equals total area of coverage.



Spray types

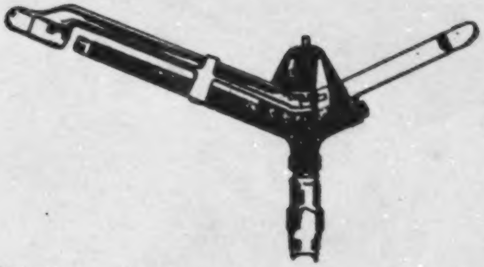
Pop-up spray valves are generally installed in systems for residential lawn areas.



Board across trench

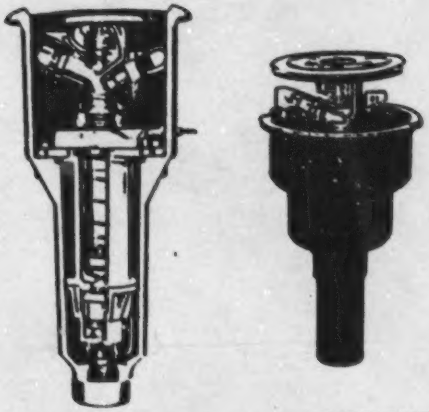
Sprinkler head supported by L hooks

Sprinkler heads can be supported with a board across the ditch during backfilling. This assures proper alignment of the sprinkler head with ground level.



Rotary type

This rotary head can be permanently mounted above ground level.



Pop-up Rotary

Pop-up rotary type heads will cover large areas of lawn. Cutaway shows spring arrangement which retracts nozzle after water is shut off.

JOB SHEET #1--INSTALL A LAWN SPRINKLER SYSTEM

EVALUATION: Given a water supply source, an outside area 50' long and 10' wide, and appropriate tools, install 3/4" P.V.C. pipe and sprinkler heads underground for lawn water service. Completed work must provide uniform coverage of the lawn area with water when the sprinkling system is activated. Joints must not leak.

I. Tools and equipment

   A. 50' steel tape

   B. Nylon string

   C. Shovel (square pointed)

   D. P.V.C. pipe

   E. P.V.C. fittings

   F. Sprinkler heads

   G. P.V.C. solvent cement with brush

   H. P.V.C. solvent cleaner with brush

   I. Hand saw

   J. Pocket knife

   K. Pipe joining equipment for connection from sprinkler system to main house system

   L. Plastic sheeting

II. Procedure

   A. Lay out trench lines, considering desired amount of water overlap required for complete coverage

   B. Remove rod and save

   C. Dig trench for water lines

   (NOTE: Lay excavated earth on plastic sheeting to avoid damage to lawn.)

   D. Lay pipe, vertical tee, and riser in trench for each sprinkler head

   E. Connect sprinkler supply line to source of water with vacuum breaker

   (NOTE: Install a cut-off valve for supply line.)

F. Install vertical tee in sprinkler line

G. Install riser in vertical tee

H. Flush the line out with water

I. Install sprinkler head on riser

J. Cap end of sprinkler line

K. Test system for coverage

L. Fill trenches

M. Return sod

N. Check with instructor for evaluation of job

O. Return all tools and equipment

AUXILIARY SYSTEMS
UNIT I

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Residential pool larger than a bathtub, but smaller than a swimming pool, intended as a hydro-massage with water and/or air jets which circulate the water

_____b. Piping arrangement designed to spray irrigation water on lawns, gardens, or other areas

_____c. Device used to spray or disperse water in an evenly distributed pattern

_____d. Device attached to spa which draws surface water off and directs it to the filter

_____e. Device in circulating pipe line which extracts minute solid materials from the bathing water

_____f. Device designed to allow air into the water circulating system to help provide turbulence and a massaging effect

1. Sprinkler head
2. Air injector
3. Sprinkler system
4. Filter
5. Spa
6. Skimmer

2. Select true statements concerning functions of the residential spa by placing an "X" in the appropriate blanks.

_____a. Provides private bathing for one or more persons

_____b. Provides no device to filter water

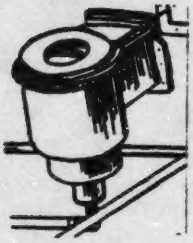
_____c. Provides heated water in a multi-person bath

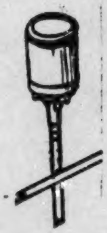
_____d. Provides for electrical outlets to be situated handily nearby

_____e. Provides a turbulent action for a water massage

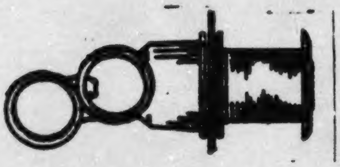
_____f. Provides privacy for a social function centered about activities in a bath

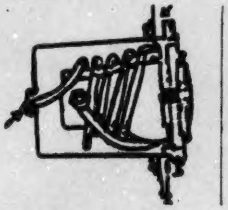
3. Identify components of a residential spa.



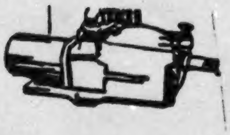


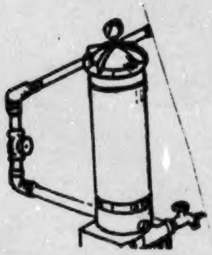
a. ______________________ b. ______________________





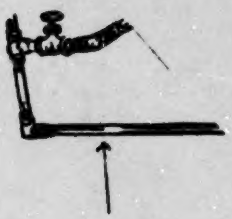
c. ______________________ d. ______________________



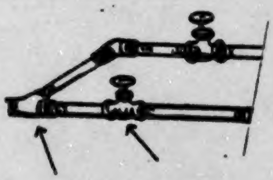


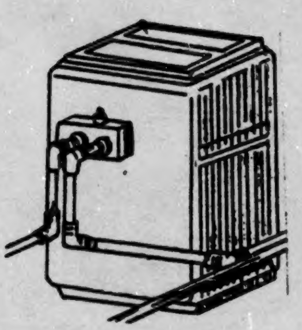
e. ______________________ f. ______________________

22-F

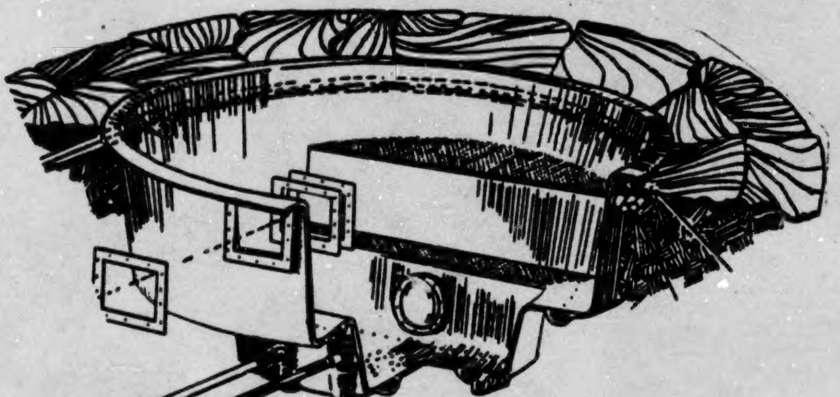


g. ____________________





h. ____________________ i. ____________________



j. ____________________

4. Discuss four items to be considered in designing a sprinkler system.

   a.

   b.

   c.

   d.

5. List three items to be considered in developing a layout for a sprinkler system.

   a.

   b.

   c.

6. Name three items used to excavate trenches for sprinkler systems.

   a.

   b.

   c.

7. Select the types of pipe most commonly used for sprinkler systems by placing an "X" in the appropriate blanks.

   _____a. Copper tubing

   _____b. P.E. (polyethylene)

   _____c. Galvanized steel

   _____d. P.V.C. (polyvinylchloride)

   _____e. Vitrified clay

8. Select the types of fittings and methods of joining most commonly used for sprinkler systems by placing an "X" in the appropriate blanks.

   _____a. Steel by the caulking method

   _____b. P.E. by the insertion method

   _____c. Cast iron by the no-hub method

   _____d. Copper by the flare method

   _____e. P.V.C. by joining with solvent cement

   _____f. P.E. by the compression method

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9. State the purpose of drain valves in a sprinkler system.

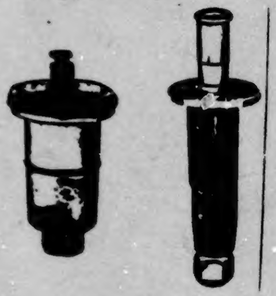
10. List three sources of water for a residential sprinkler system.

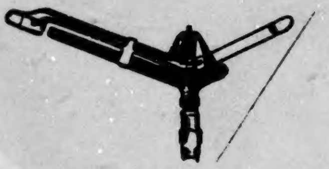
a.

b.

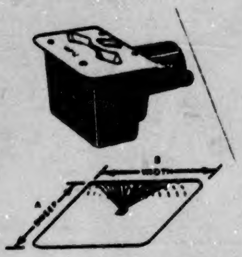
c.

11. Identify three types of sprinkler heads.





a. ______________________ b. ______________________



c. ______________________

12. List four sources of pressure allowance due to friction loss.

a.

b.

c.

d.

13. Select correct methods used to minimize pressure drop by placing an "X" in the appropriate blanks.

______a. Keep pipe runs as long as possible

______b. Keep fittings to a minimum

______c. Divide system into several units which sprinkle at different times

14. Demonstrate the ability to install a lawn sprinkler system.

(NOTE: If this activity has not been accomplished prior to the test, ask your instructor when it should be completed.)

AUXILIARY SYSTEMS
UNIT I

ANSWERS TO TEST

1. a. 5

   b. 3

   c. 1

   d. 6

   e. 4

   f. 2

2. a, c, e, f

3. a. Skimmer

   b. Air injector

   c. Whirlpool jet inlet

   d. Spa light

   e. Pump

   f. Filter

   g. Piping

   h. Fittings

   i. Heater (gas)

   j. Tub or spa

4. Discussion should include: —

   a. Design must provide for controlled coverage of the area to be watered

   b. Sprinkler system must make the most of existing water pressure

   c. Cost of the sprinkler system should include maintenance and repair

   d. In cold climates, the system must be designed to prevent freeze damage

5. a. Location of the water sources
   b. Location of the controls
   c. Layout of the sprinkler heads
6. a. Hand shovel
   b. Power trencher
   c. Power pipe layer
7. b, d
8. e, f
9. Drain valves are installed in all low points of piping to prevent piping from freezing
10. a. Existing hose bibs
    b. Cutting into main water system
    c. Adding separate line direct from city water main
11. a. Spray type
    b. Rotary type
    c. Wave type (oscillating)
12. a. Diameter of pipe
    b. Length of pipe
    c. Number of fittings
    d. Type of fittings used
13. b, c
14. Performance skill evaluated to the satisfaction of the instructor

—

WATER VALVES AND FAUCETS
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to identify various types of valves, parts of a valve, and types of faucets. The student should also demonstrate the ability to install valves and faucets. This knowledge will be evidenced by correctly performing the procedures outlined on the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with water valves and faucets to the correct definitions or descriptions.
2. Identify three types of valves.
3. Match the parts of a valve to the correct locations.
4. Identify types of faucets.
5. Select features which best describe specific faucets.
6. Demonstrate the ability to:
   a. Install a stop and waste valve (solder method).
   b. Install a kitchen sink faucet.
   c. Install a Dual Control Lavatory Faucet with Pop-Up Drain Plug.
   d. Disassemble and reassemble a single lever kitchen sink faucet.

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WATER VALVES AND FAUCETS
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss the procedures outlined in the job sheets.

   G. Disassemble several basic types of valves for the student to study.

   H. Conduct a trip of the school facilities showing specific application of various types of valves.

   I. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Types of Valves

      2. TM 2--Parts of a Globe Valve

      3. TM 3--Parts of a Gate Valve

      4. TM 4--Parts of Check Valves

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5. TM 5–Types of Faucets - Dual Control

6. TM 6–Types of Faucets - Single Control

D. Job sheets

1. Job Sheet #1–Install a Stop and Waste Valve (Solder Method)

2. Job Sheet #2–Install a Kitchen Sink Faucet

3. Job Sheet #3–Install a Dual Control Lavatory Faucet with Pop-Up Drain Plug

4. Job Sheet #4–Disassemble and Reassemble a Single Lever Kitchen Sink Faucet

G. Test

H. Answers to test

II. References:

A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, IL: Goodheart-Willcox, 1978.

B. *Delta Faucet Catalog.* Indianapolis, Indiana: Delta Faucet Company, 1979.

C. *Plumbing Curriculum: Valves.* Ontario, Canada: Ministries of Colleges and Universities, 1978.

WATER VALVES AND FAUCETS
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Valve--A mechanical device which regulates the flow of liquid in a pipe

   B. Faucet--A fixture used for drawing liquid from a pipe

   C. Stop and waste valve--A valve which has a drain plug on the discharge side and is used as a cut-off valve

   D. Spread--The distance between valve shanks on a sink and lavatory faucet

      (NOTE: Spread is measured from the center of one inlet to the center of the other inlet.)

   E. Diverter--Bath and shower faucet used to change flow from tub filler to shower head or in the reverse directions

   F. Escutcheon--Chromed metal shield over valve body of faucets used to give the faucet an attractive appearance

II. Types of valves (Transparency 1)

   A. Globe

   B. Gate

   C. Check

III. Parts of a valve (Transparencies 2, 3, and 4)

   A. Stem

   B. Screw (Rising stem)

   C. Composition disc

   D. Disc retaining nut

   E. Wheel nut

   F. Wheel

   G. Packing gland

   H. Packing nut

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INFORMATION SHEET

I. Packing

J. Union bonnet

K. Disc holder

L. Body

IV. Types of faucets

A. Dual control (Transparency 5)

1. Two compression valves
2. Two noncompression valves

B. Single control (Transparency 6)

1. Rotating ball valve
2. Rotating cylinder valve

V. Features of faucets

A. Kitchen sink faucet

1. Swing spout (deck or wall mount)
2. Spray
3. Hot and cold water valves
4. Aerator
5. Single and dual control valves
6. Usually 8" centers (dual control)

B. Lavatory faucet

1. Stationary spout
2. Hot and cold water valves
3. Single and dual control valves
4. Usually 4"centers (Dual control)
5. Usually supplied with pop-up drain fitting

INFORMATION SHEET

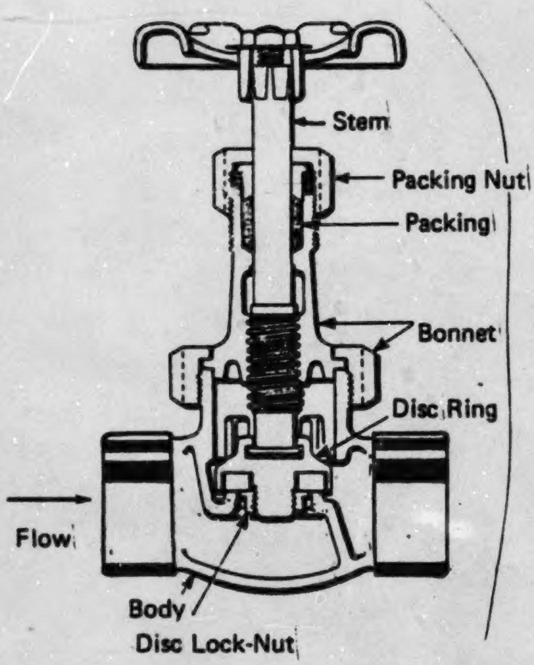
C. Bath and shower faucet

  1. Stationary spout
  2. Hot and cold water valves
  3. Single and dual control valves
  4. Shower head
  5. Usually 8" centers (dual control)
  6. Main body of valve and water piping installed during rough-in

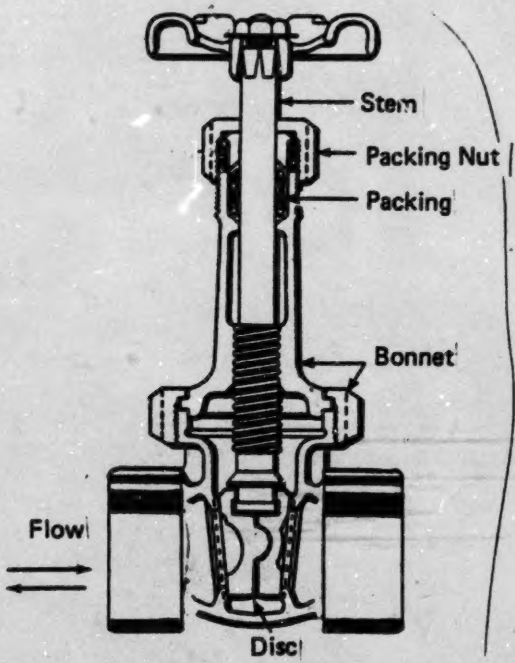
D. Shower faucet

  1. Hot and cold water valves
  2. Single and dual control valves
  3. Shower head
  4. Usually 8" centers (dual control)
  5. Main body of valve and water piping installed during rough-in

Types Of Valves

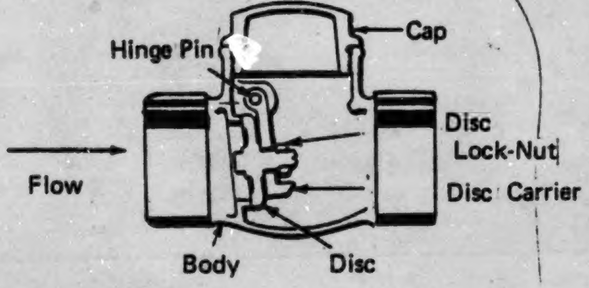

Stem
Packing Nut
Packing
Bonnet
Disc Ring
Flow
Body
Disc Lock-Nut

Globe

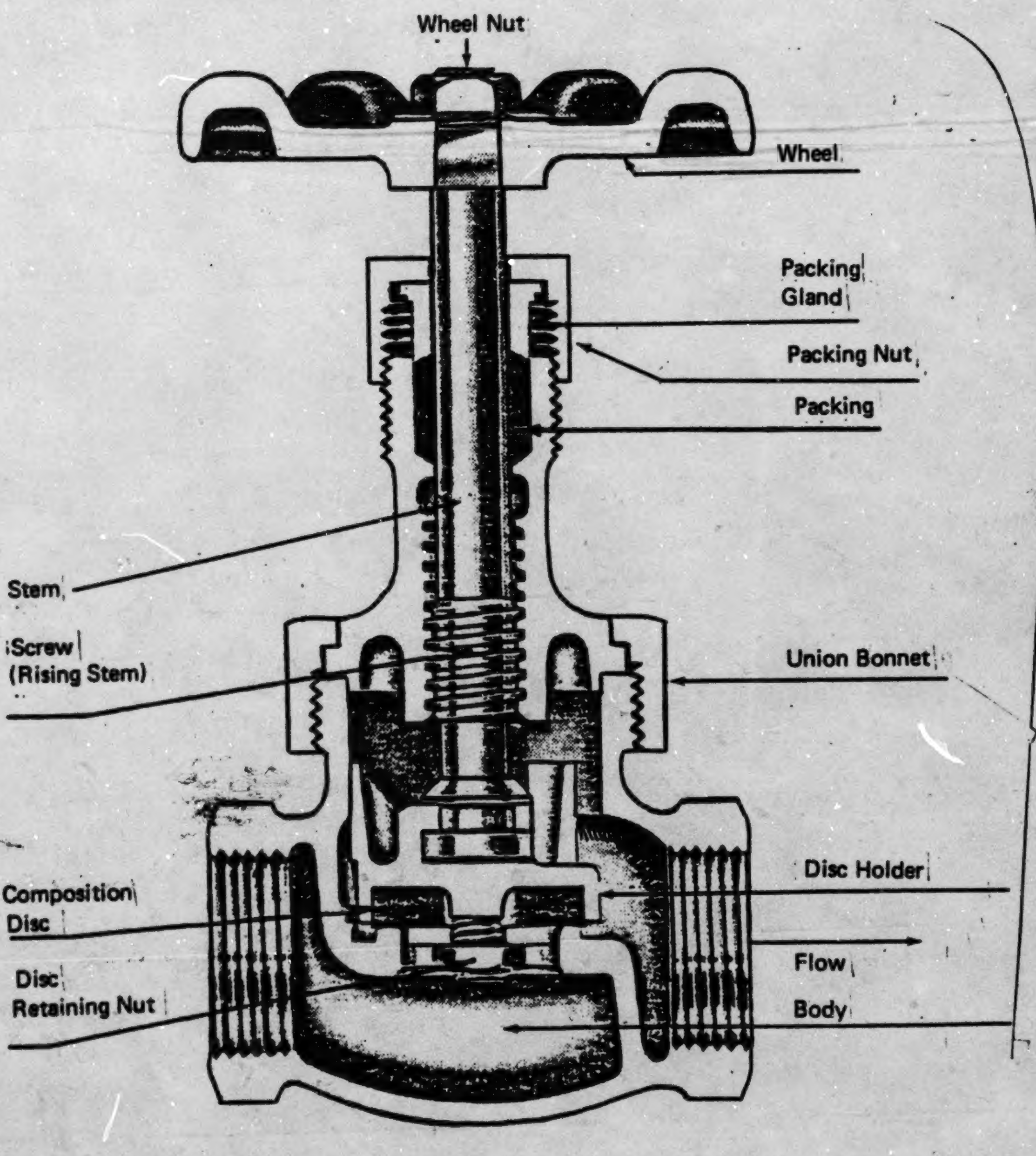

Stem
Packing Nut
Packing
Bonnet
Flow
Disc

Gate

Swing Check Valve

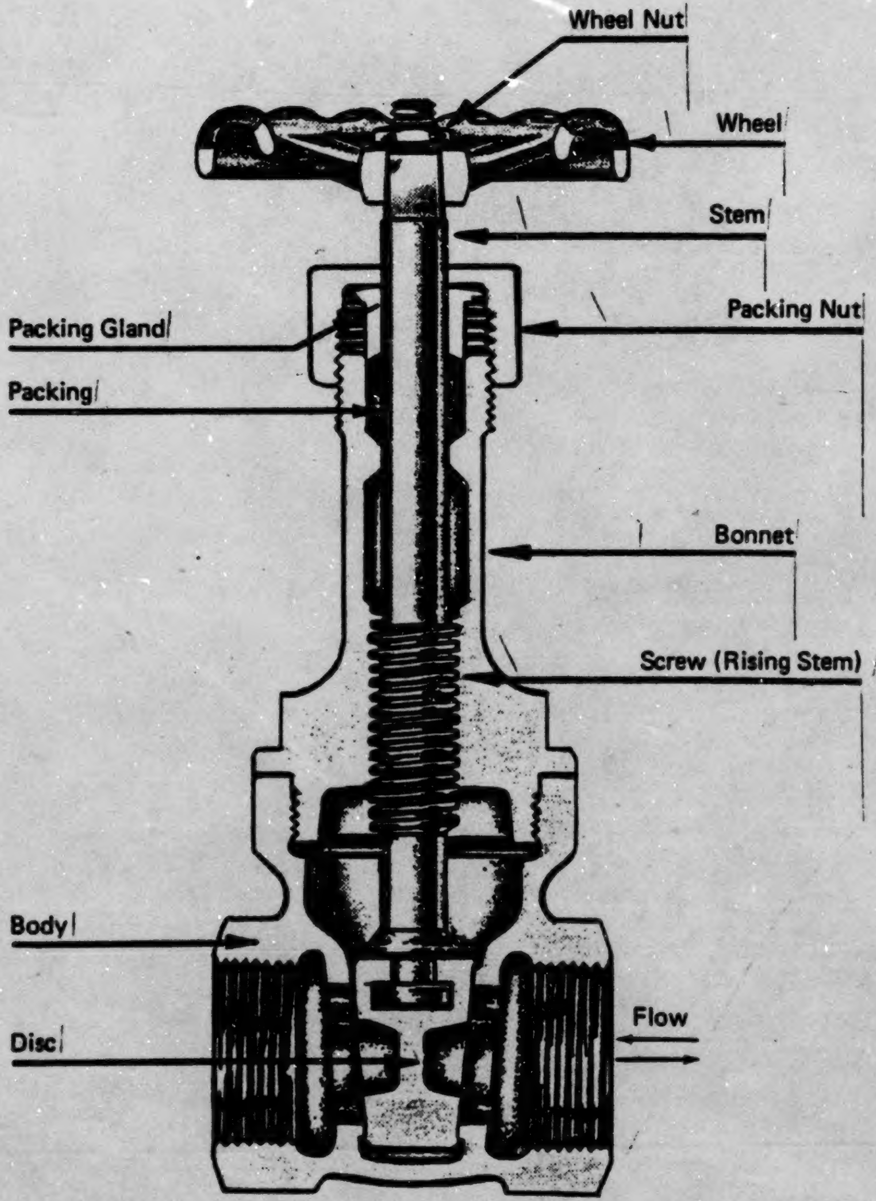

Cap
Hinge Pin
Disc
Lock-Nut
Disc Carrier
Flow
Body
Disc

Parts of A Globe Valve


Wheel Nut
Wheel
Packing Gland
Packing Nut
Packing
Stem
Screw (Rising Stem)
Union Bonnet
Disc Holder
Composition Disc
Flow
Disc Retaining Nut
Body

Parts of a Gate Valve

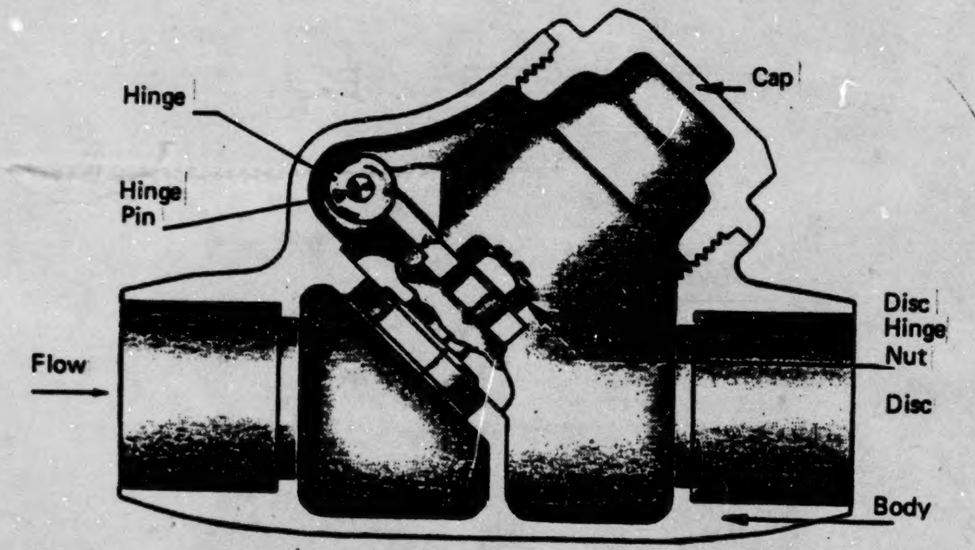
Solid Wedge Gate Valve


Wheel Nut
Wheel
Stem
Packing Nut
Packing Gland
Packing
Bonnet
Screw (Rising Stem)
Body
Disc
Flow

Parts of Check Valves

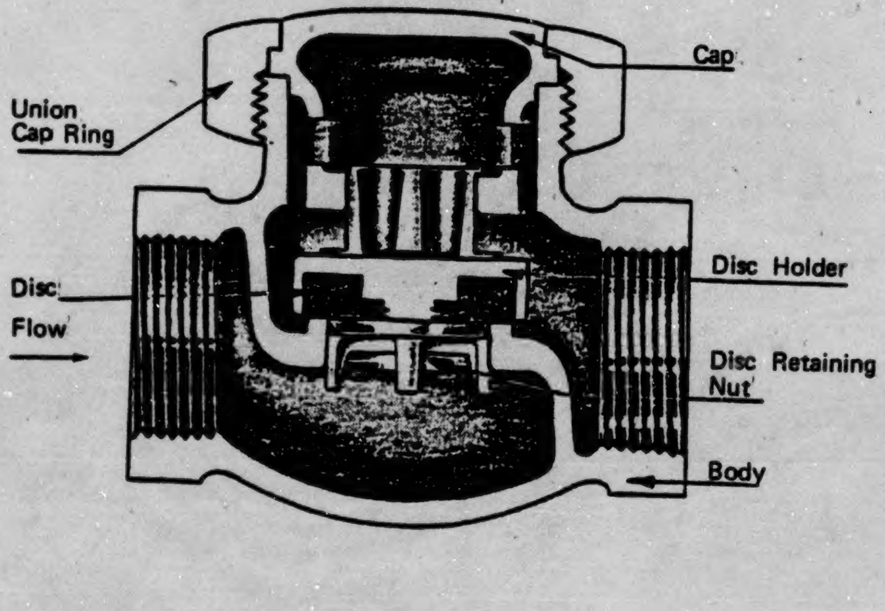
Screwed Cap Type "Y" Pattern

Swing Check


Hinge
Hinge Pin
Cap
Flow
Disc Hinge Nut
Disc
Body

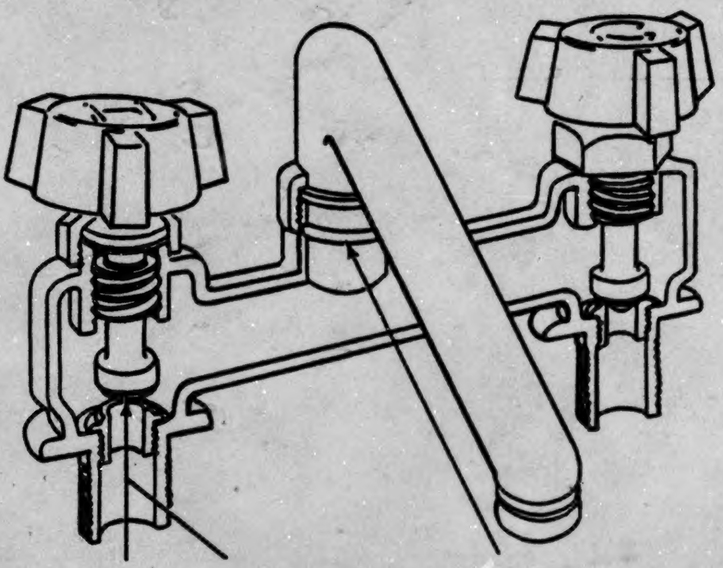
Union Cap Type

Lift Check

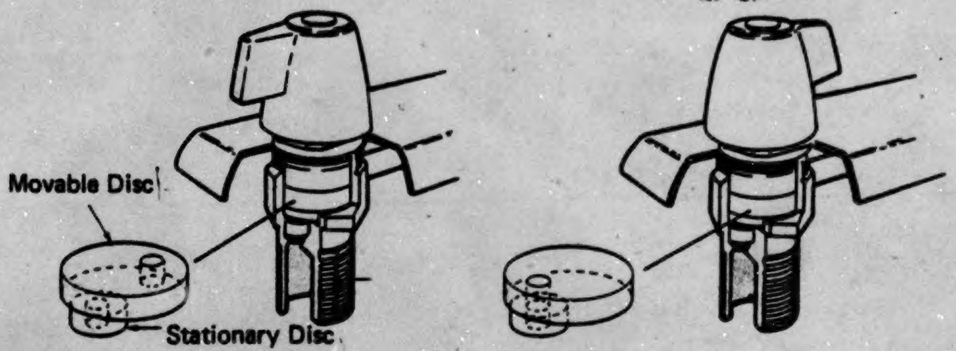

Cap
Union Cap Ring
Disc
Flow
Disc Holder
Disc Retaining Nut
Body

Types of Faucets

Dual Contol



Two Compression Valves


Movable Disc
Stationary Disc

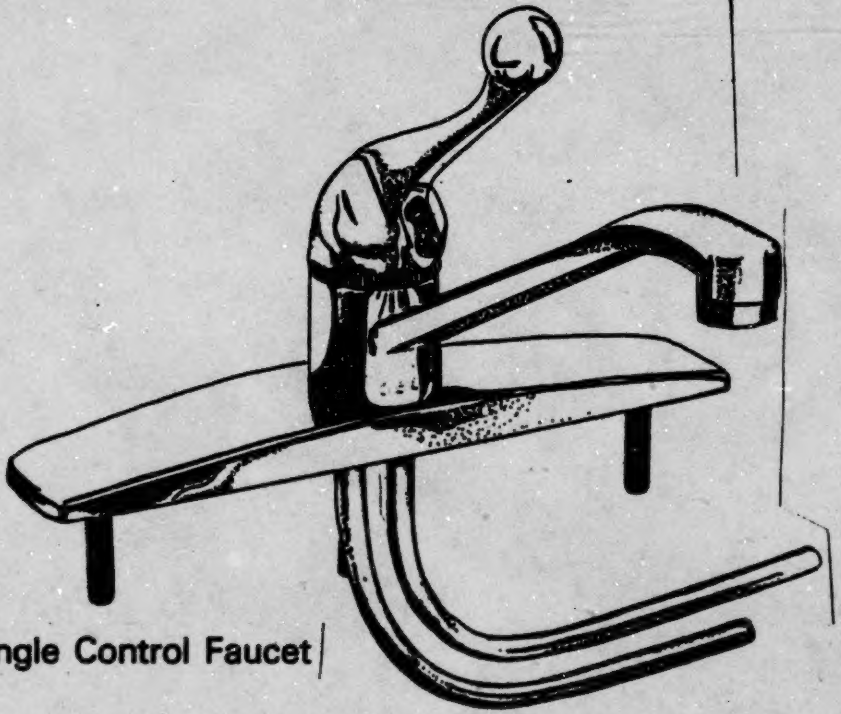
Valve in off position holes do not align

Valve in on position-holes align

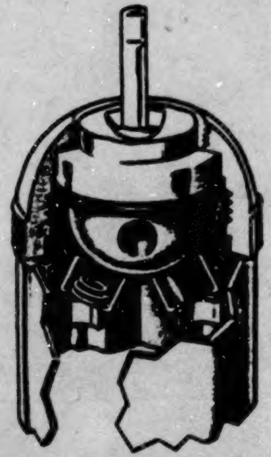
Two Non-compression Valves

Types of Faucets

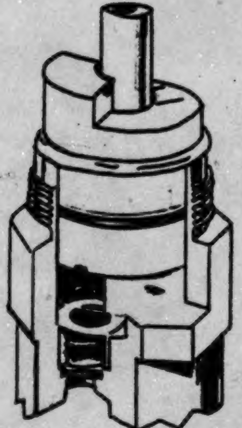
Single Control



Single Control Faucet



Rotating Ball Valve



Rotating Cylinder Valve

WATER VALVES AND FAUCETS
UNIT II

JOB SHEET #1--INSTALL A STOP AND WASTE VALVE (SOLDER METHOD)

EVALUATION--Given access to tools and equipment, install a stop and waste valve in a water line. Connections must not leak and water must flow through valve at a normal rate to the satisfaction of the instructor.

I. Tools and equipment

  A. Stop and waste valve (brass)

  B. Short lengths of copper tubing (rigid)

  C. Pipe vise

  D. Soldering tools

    1. Torch and tank outfit

    2. Striker

    3. Solder

    4. Flux

    5. Flux brush

    6. Clean cloth

    7. Sand cloth

    8. Fitting brush

    9. Safety glasses

  E. Combination slip-joint pliers

II. Procedure

  (NOTE: Put safety glasses on.)

  A. Gather all the tools and equipment and carry to the job site (work bench)

  B. With sand cloth, clean one end of two pieces of copper tubing

  C. Place one piece of tubing in pipe vise (horizontal position)

D. Open valve

(NOTE: When opening valves, the valve should be completely opened and then turned back a short turn. This will prevent sticking if left open for long periods of time.)

E. Remove waste (knurled cap)

(CAUTION: Do not lose washer that is located inside cap.)

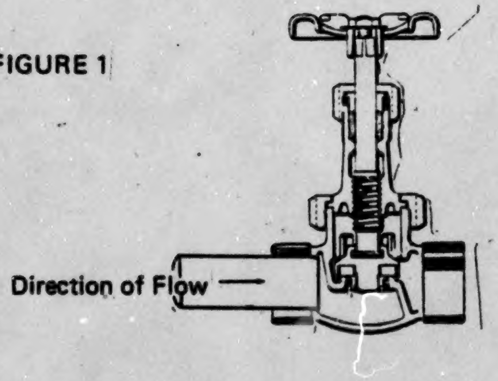
F. Clean valve cups with fitting brush

G. Apply flux to valve cups and to end of pipe in vise

H. Determine direction of water flow and place valve on tube in vise (Figure 1)

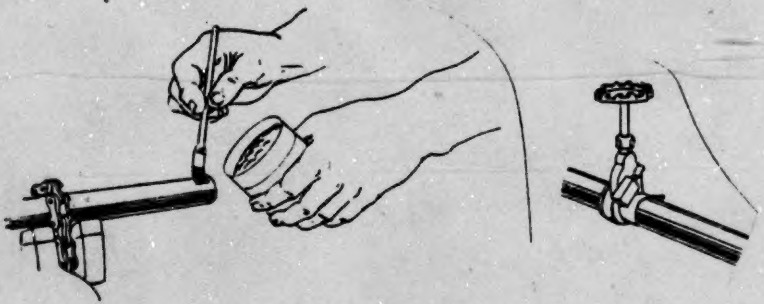
(NOTE: It is good practice to remove valve stem before soldering.)

FIGURE 1



I. Apply flux to end of other tube and insert in outlet end of valve (Figure 2)

FIGURE 2



JOB SHEET #1

J. Set up and light the torch

K. Solder the joints

(NOTE: Apply just enough heat and solder.)

L. Wipe off excess solder

M. Allow to cool before closing valve and replacing waste cap

(NOTE: Be sure cap washer is in correct position.)

N. Put all tools and equipment away and clean up the area

WATER VALVES AND FAUCETS
UNIT II

JOB SHEET #2--INSTALL A KITCHEN SINK FAUCET

EVALUATION--Given access to tools and equipment, install a dual control kitchen sink faucet. Instructor will evaluate methods of workmanship used, safety precautions taken, accuracy of installation, and general appearance of the finished job.

I. Tools and equipment

- A. Dual control kitchen faucet
- B. Sink
- C. Basket strainer
- D. 3' piece of 1/2" copper tubing, type L
- E. Two 3/8" speedy connectors
- F. Two 3/8" compression x 1/2" sweat adapters
- G. Two 1/2" stop and waste valves
- H. Two 1/2" 90° elbows
- I. Two 1/2" 45° elbows
- J. Putty
- K. Spud wrench
- L. 12" adjustable pliers
- M. Pipe tape and pipe compound
- N. Basin wrench
- O. Torch and tank assembly
- P. Striker
- Q. Solder
- R. Flux
- S. Flux brush
- T. Fitting brush

JOB SHEET #2

U. Sand cloth

V. Clean cloth

W. Strainer wrench

X. Lock nut wrench

Y. Two 1/2" escutcheons

II. Procedure

A. Gather all tools and equipment and carry to job site

B. Take the faucet out of the package and check for missing parts

C. Remove sink from box and check for damage

D. Cut 2 lengths (about 10") copper tubing

E. Clean ends of tubing with sand cloth and apply flux

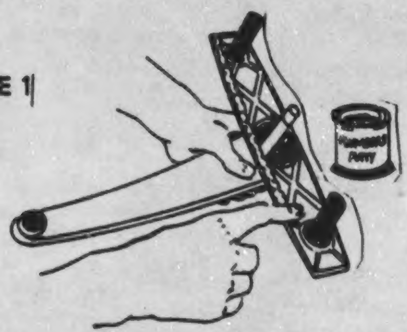
F. Clean male adapters with fitting brush and apply flux

G. Light torch and solder adapters onto each 10" pipe

(NOTE: Set these aside to cool.)

H. Apply putty to base of faucet escutcheon (Figure 1)

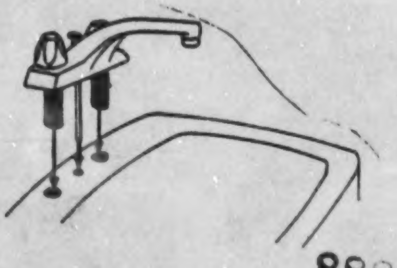
FIGURE 1



I. Place rubber washer on base of faucet

J. Insert faucet into sink holes (Figure 2)

FIGURE 2



JOB SHEET #2

K. Turn sink on edge

L. Place metal washers and nuts on faucet shanks

M. Pull the nuts tight with the spanner wrench

(NOTE: Check that the faucet is straight on the sink.)

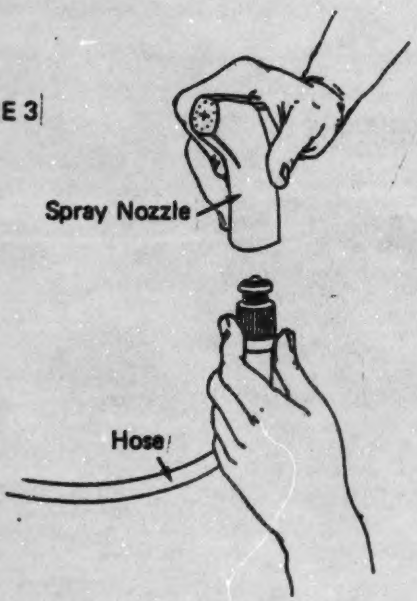
N. Install spray hose escutcheon in spray hole

(NOTE: Apply putty under escutcheon before installing.)

O. Remove the spray nozzle from the hose

P. Connect hose to faucet body (Figure 3)

FIGURE 3



Q. Push other end of hose through spray hole in sink

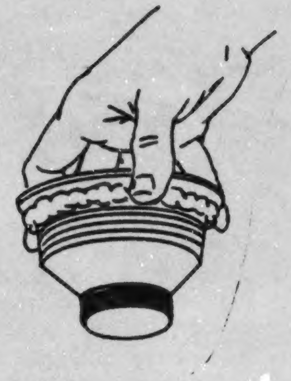
R. Connect spray nozzle

S. Remove basket strainer from box and disassemble

JOB SHEET #2

T. Place putty on the underside of the basket strainer rim (Figure 4)

FIGURE 4



U. Place basket strainer in drain hole

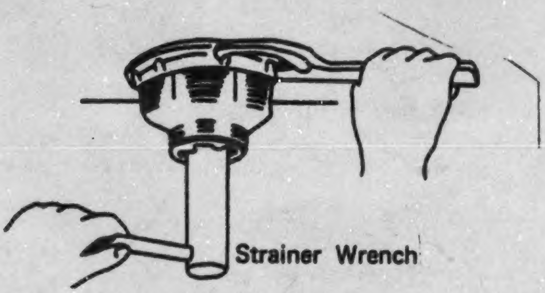
V. Stand sink on edge

W. Place fiber washer on underside of basket strainer followed by the large metal washer and nut

(NOTE: A little pipe dope helps pull the nut tight.)

X. Pull the nut tight using strainer wrench and lock nut wrench (Figure 5)

FIGURE 5



Y. Apply pipe compound to 1/2" male adapters

Z. Install on valve shanks

(NOTE: Some faucets are made to receive both male or female adapters.)

JOB SHEET #2

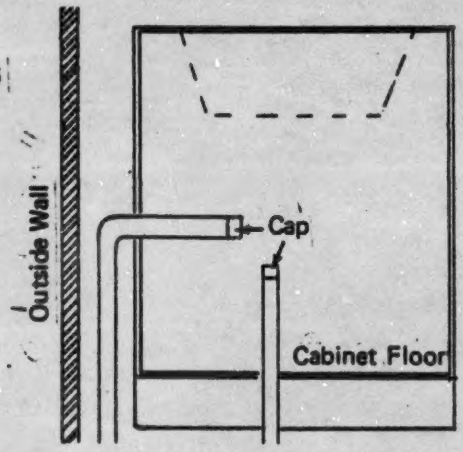
AA. Install the sink into the counter top

(NOTE: Check with instructor as to the various rims and installation methods.)

BB. Cut the test cap off the 1/2" copper tube risers using a small tubing cutter or a close tubing cutter (Figure 6)

(NOTE: 1/2" copper tubing should extend vertically through sink cabinet floor or horizontally through the back wall of cabinet.)

FIGURE 6



CC. Clean riser ends and drops from faucet with sand cloth

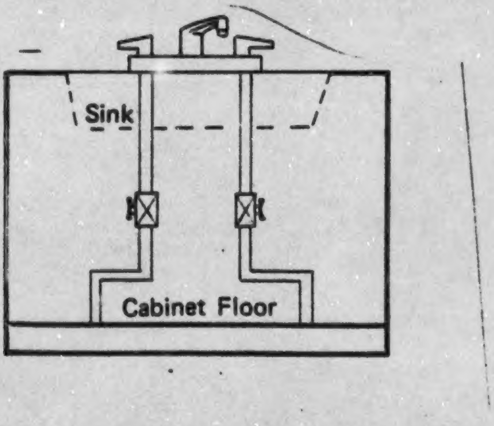
(NOTE: Install escutcheons before connecting tubing.)

DD. Clean fittings and valves with fitting brush

EE. Flux tubing ends, fittings and valves

FF. Place valves on drop ends and connect valves to risers using 90° and 45° elbows if necessary (Figure 7)

FIGURE 7



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JOB SHEET #2

GG. Solder fittings

HH. Wipe clean

II. Remove spout aerator

JJ. Turn on water to flush out system

KK. Shut off water

LL. Replace aerator

MM. Clean up the area

NN. Put tools and equipment away

WATER VALVES AND FAUCETS
UNIT II

JOB SHEET #3--INSTALL A DUAL CONTROL LAVATORY FAUCET WITH POP-UP DRAIN PLUG

EVALUATION--Given access to tools and equipment, install a dual control lavatory faucet. Instructor will evaluate the job on use of safety precautions, correct methods, and general appearance of the finished job.

I. Tools and equipment

(NOTE: Lavatory installation is included in Unit IV.)

A. Lavatory faucet with pop-up drain

B. Lavatory

C. Putty

D. 8" adjustable wrench

E. Spanner wrench

F. 10" adjustable pliers

G. Pipe dope

H. Plug wrench

I. Clean wiping cloth

J. Cloth or plastic for floor protection

II. Procedure

A. Gather all tools and equipment and carry to work site

(NOTE: Provide floor protection.)

B. Remove faucet and drain from box and check for missing parts

C. Remove lavatory from carton and check for damage

D. Remove shank nuts, washers, and gasket

E. Place putty under faucet escutcheon

F. Replace rubber or plastic gasket

G. Insert faucet valve shanks through lavatory holes

H. Press down tightly

JOB SHEET #3

I. Place metal washers and locknuts on shanks

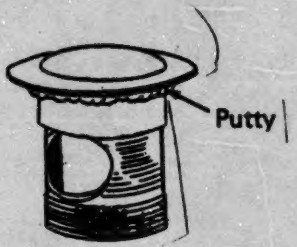
J. Pull tight with spanner wrench

(NOTE: Check to be sure that the faucet is straight on the lavatory.)

K. Disassemble drain plug

L. Place a bead of putty under drain lip (Figure 1)

FIGURE 1



M. Place drain plug in sink outlet

(CAUTION: China lavatories can break easily; use care when installing drains and faucets.)

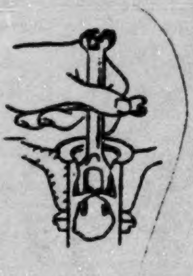
N. Slip rubber gasket onto the lower end

O. Place the metal washer and nut behind the rubber gasket

P. Pull tightly with the spud wrench (Figure 2)

(NOTE: Hold the drain plug in place with a plug wrench.)

FIGURE 2



Q. Screw the drain body onto the drain plug

(NOTE: The drain body side-outlet must face the rear of the lavatory.)

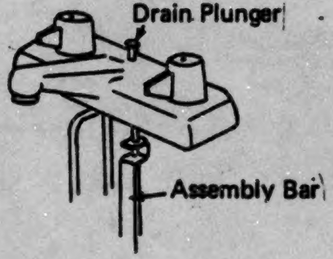
JOB SHEET #3

R. Screw the tail piece into the drain body

S. Insert the drain plunger through the faucet body

T. Connect to the lever assembly bar (Figure 3)

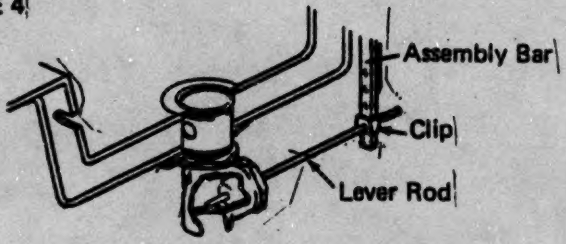
FIGURE 3



U. Secure lever rod in assembly bar using lever rod clip

V. Insert rod into drain body (Figure 4)

FIGURE 4



W. Tighten rod nut

X. Slip assembly bar up onto the drain plunger

(NOTE: Do not tighten lock screw.)

Y. Determine approximate location of rod-bar connection and make the connection

Z. Tighten lock screw on assembly bar

AA. Check pop-up drain for correct action

(NOTE: Lift drain plunger up and down.)

JOB SHEET #3

BB. Pull lever rod all the way down

CC. Loosen assembly bar lock screw

DD. Raise drain plunger about 1/8" inch

EE. Tighten lock screw

(NOTE: The drain plunger handle should not touch the faucet body when pressed down.)

FF. Install the lavatory

(NOTE: See Unit IV, Fixture and Appliance Installation.)

GG. Put all tools away

HH. Clean up area

II. Check with instructor for evaluation of job

WATER VALVES AND FAUCETS
UNIT II

JOB SHEET #4--DISASSEMBLE AND REASSEMBLE A SINGLE LEVER KITCHEN SINK FAUCET

(NOTE: The Moen "Chateau" is illustrated here.)

EVALUATION--Given access to tools and equipment, disassemble and reassemble a single lever kitchen faucet. Instructor evaluation will include care in handling chrome finished parts, care in handling delicate parts of the faucet, ability to follow directions, and the ability to use bench tools properly.

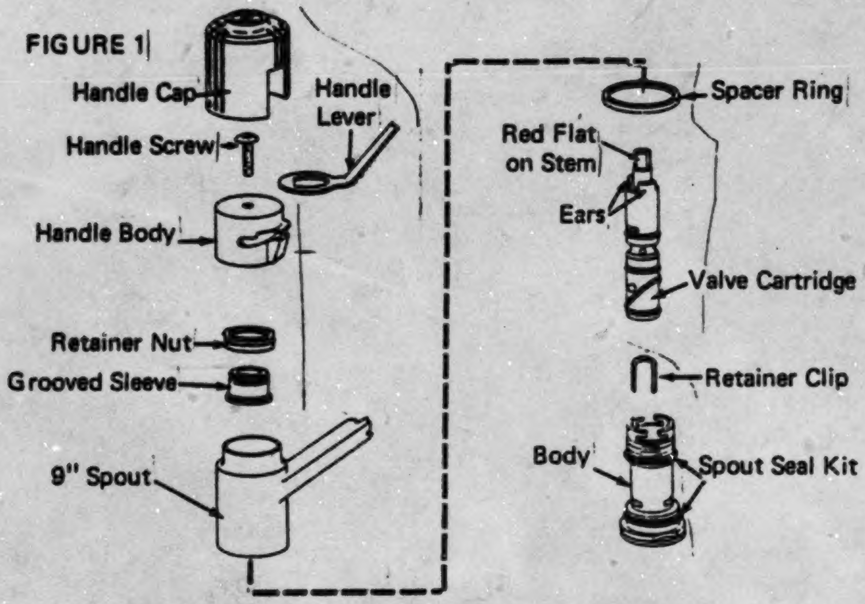
I. Tools and equipment

- A. Single lever kitchen sink faucet
- B. Phillips head screwdrivers
- C. Straight head screwdrivers
- D. Pair combination pliers
- E. 8" Adjustable wrench
- F. Wiping cloth

II. Procedure

(NOTE: Refer to Figure 1.)

FIGURE 1


Handle Cap
Handle Lever
Handle Screw
Handle Body
Retainer Nut
Grooved Sleeve
9" Spout
Spacer Ring
Red Flat on Stem
Ears
Valve Cartridge
Retainer Clip
Body
Spout Seal Kit

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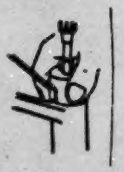
JOB SHEET #4

A. Diassemble

1. Turn "off" both hot and cold water supplies
2. Pull handle cap up and off

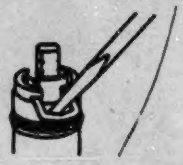
   (NOTE: It snaps into place.)
3. Remove the handle screw
4. Lift and tilt handle and handle body off (Figure 2)

FIGURE 2



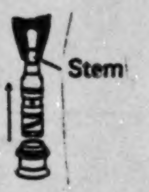
5. Remove retainer nut and lift off grooved sleeve
6. Lift and twist spout off
7. Pry out retainer clip with screwdriver (Figure 3)

FIGURE 3



8. Grasp cartridge stem with pliers and lift cartridge out (Figure 4)

FIGURE 4



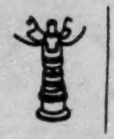
9. Flush supply lines by turning on the hot and cold water supplies slowly

JOB SHEET #4

B. Reassemble

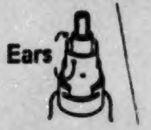
1. With cartridge stem UP, insert and push down cartridge by its ears (Figure 5)

FIGURE 5



2. Turn cartridge ears to front and back as shown (Figure 6)

FIGURE 6



3. Turn red (notched) flat of cartridge stem toward sink

4. Replace clip all the way

5. Replace spout

   (NOTE: Push down until it nearly touches the faucet escutcheon.)

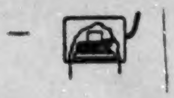
6. Place grooved sleeve on top of body and screw on retainer nut

   (NOTE: Tighten snugly but be careful not to cross thread.)

7. Press cartridge stem down

8. Holding handle UP, hook ring in handle housing into groove on sleeve (Figure 7)

FIGURE 7



9. Swing handle back and forth until it drops into place

10. Replace handle screw and tighten securely

JOB SHEET #4

11. Push handle cap down until it snaps into place

12. Check with instructor for evaluation of job

13. Clean up the area and return all tools and equipment

WATER VALVES AND FAUCETS
UNIT II

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. A mechanical device which regulates the flow of liquid in a pipe

_____b. A fixture used for drawing liquid from a pipe

_____c. A valve which has a drain plug on the discharge side and is used as a cut-off valve

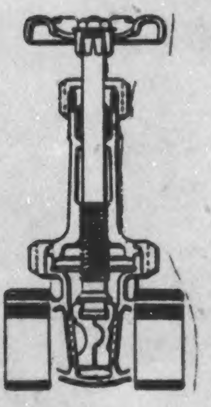
_____d. The distance between valve shanks on a sink and lavatory faucet

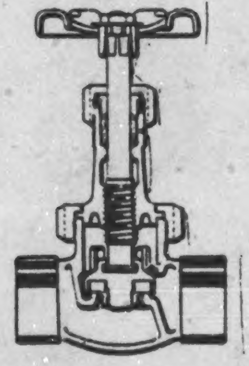
_____e. Bath and shower faucet used to change flow from tub filler to shower head or in the reverse direction

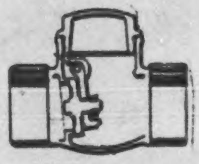
_____f. Chromed metal shield over valve body of faucets used to give the faucet an attractive appearance

1. Faucet
2. Diverter
3. Escutcheon
4. Spread
5. Valve
6. Stop and waste valve

2. Identify three types of valves.







a. _______________ b. _______________ c. _______________

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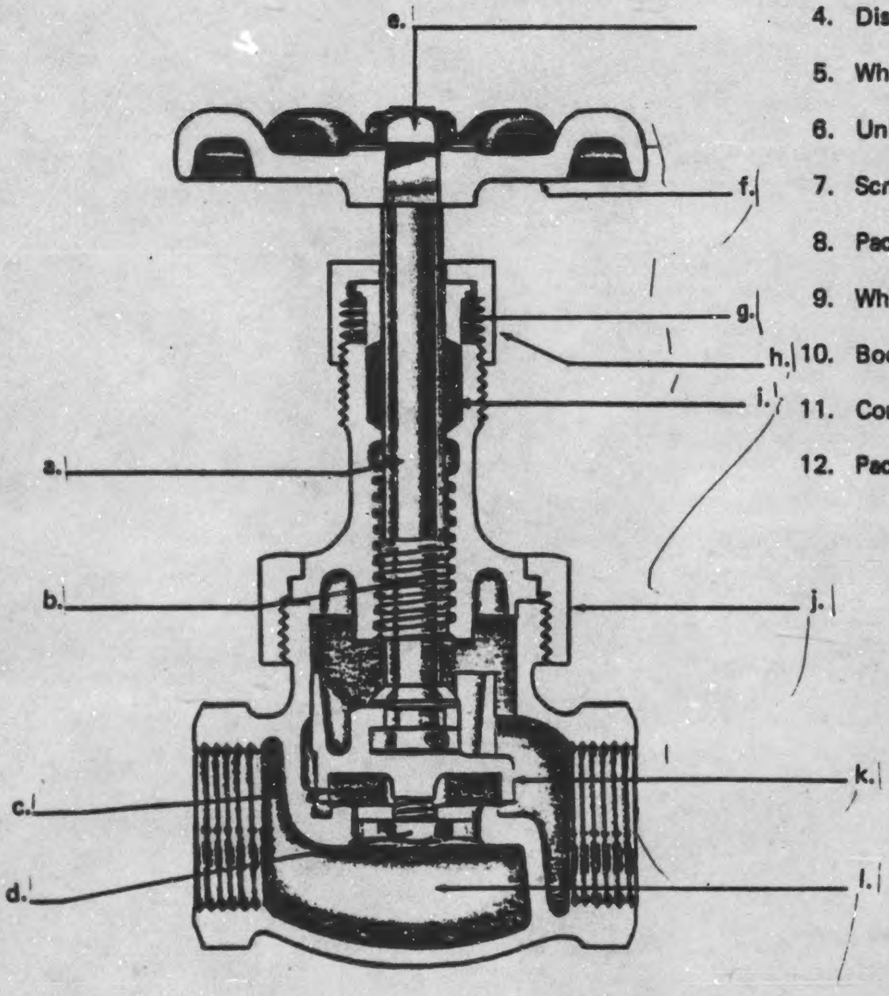
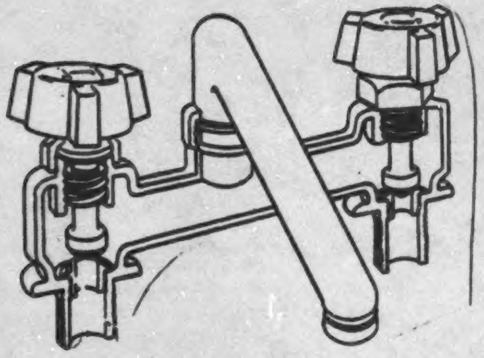
3. Match the parts of a valve on the right to the correct locations.

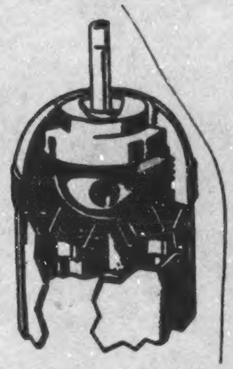


1. Stem
2. Disc holder
3. Packing gland
4. Disc retaining nut
5. Wheel nut
6. Union bonnet
7. Screw (Rising stem)
8. Packing
9. Wheel
10. Body
11. Composition disc
12. Packing nut

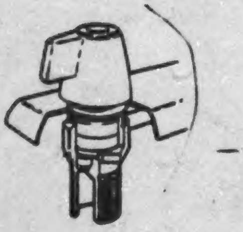
ll-F

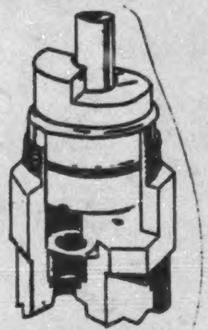
4. Identify types of faucets.





a. ______________________ b. ______________________





c. ______________________ d. ______________________

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WATER VALVES AND FAUCETS
UNIT II

ANSWERS TO TEST

1. a. 5
   b. 1
   c. 6
   d. 4
   e. 2
   f. 3
2. a. Gate valve
   b. Globe valve
   c. Check valve
3. a. 1
   b. 7
   c. 11
   d. 4
   e. 5
   f. 9
   g. 3
   h. 12
   i. 8
   j. 6
   k. 2
   l. 10
4. a. Dual control--Two compression valves
   b. Single control--Rotating ball valve
   c. Dual control--Non-compression valve
   d. Single control--Rotating cylinder valve
5. Should include at least four of the following features for each type of faucet:
   a. Kitchen sink faucet
      1) Swing spout (deck or wall mount)
      2) Spray
      3) Hot and cold water valves

DRAINAGE CONNECTIONS
UNIT III

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with drainage connections to definitions or descriptions, identify various drainage connections, and demonstrate the ability to install various drainage connections. This knowledge will be evidenced by correctly performing the procedures outlined on the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with drainage connections to the correct definitions or descriptions.
2. Identify various drainage connections used in residential plumbing.
3. List four ways a trap can lose its seal.
4. Demonstrate the ability to:
    a. Install a cast iron water closet flange.
    b. Install a plastic water closet flange.
    c. Install a brass to copper pipe water closet flange.
    d. Install a lavatory trap.
    e. Install a kitchen sink trap.
    f. Install a brass to lead pipe water closet flange.

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DRAINAGE CONNECTIONS
UNIT III

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide students with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss the procedures outlined in the job sheets.

   G. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Types of Drainage Connections

      2. TM 2--Types of Drainage Connections (Continued)

      3. TM 3--Loss of Trap Seal

D. Job sheets

  1. Job Sheet #1--Install a Cast Iron Water Closet Flange
  2. Job Sheet #2--Install a Plastic Water Closet Flange
  3. Job Sheet #3--Install a Brass to Copper Pipe Water Closet Flange
  4. Job Sheet #4--Install a Lavatory Trap
  5. Job Sheet #5--Install a Kitchen Sink Trap
  6. Job Sheet #6--Install a Brass to Lead Pipe Water Closet Flange

E. Test

F. Answers to test

II. References

A. Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, IL: Goodheart-Willcox, 1978.

B. *Naval Training Command: Rate Training Manual, Utilitiesman 3 and 2.* Washington, DC: U. S. Government Printing Office, 1973.

DRAINAGE CONNECTIONS
UNIT III

INFORMATION SHEET

I. Terms and definitions

  A. Basket strainer--A recessed strainer fitting into the drain outlet of a sink

  B. Capillary attraction--Movement of liquid upward through cellular structure of fibrous strands or through structure of other solids

  C. Evaporation--Loss of water (especially in a drainage trap) to the atmosphere

  D. O-ring--Rubber seal used around stems of some valves to prevent water from leaking out

  E. Plumber's putty--A soft prepared mixture used to seal sink rims, drain outlets, and other places where a sealant is needed

  F. Seal of a trap--Depth of water held in a trap under normal operating conditions

II. Types of drainage connections (Transparencies 1 and 2)

  A. Water closet flanges

    1. Cast iron

    2. PVC

    3. Brass

    (NOTE: Brass water closet flanges are used for either copper or lead.)

  B. Kitchen sink traps and wastes

    1. Single sink/vanity

    2. Double well continuous waste

      a. End outlet

      b. Center outlet

    3. Single waste - 2 traps

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INFORMATION SHEET

C. Lavatory traps

1. P-trap

2. S-trap

(NOTE: An S-trap is illegal according to most state and local codes.)

III. Loss of trap seals (Transparency 3)

A. Evaporation

(NOTE: This is usually due to fixture not being used for long periods of time.)

B. Capillary attraction

(NOTE: This is usually due to string or other substances being caught in the trap.)

C. Siphonage

(NOTE: This is usually due to improper arrangement of trap and waste piping causing high velocity of drain water.)

D. Leaks

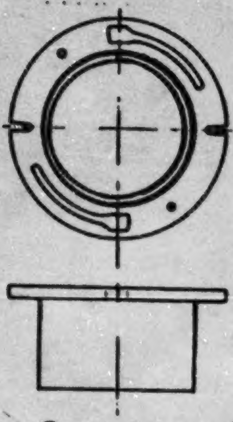
(NOTE: This is usually due to a cracked trap or loose or decayed cleanout washer.)

E. Back pressure

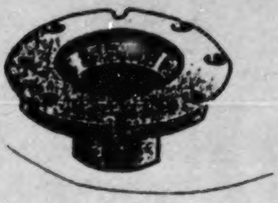
(NOTE: This is usually caused by poor venting of fixtures.)

Types Of Drainage Connections

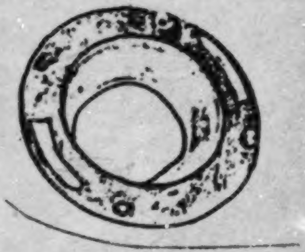
Water Closet Flanges



Cast Iron

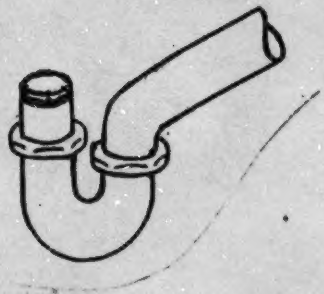


PVC

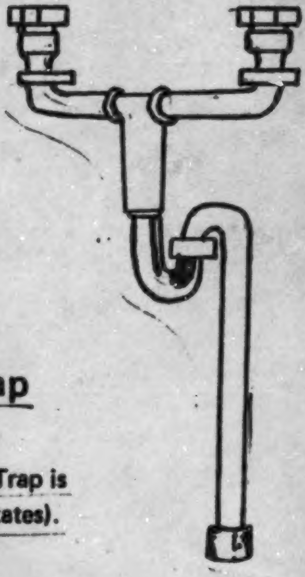


Brass

Lavatory Traps



"P" Trap



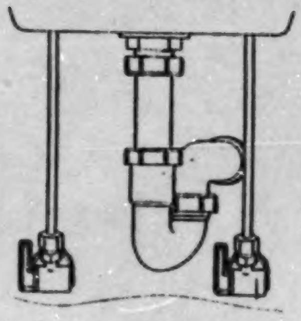
"S" Trap

(Note: The "S" Trap is illegal in most states).

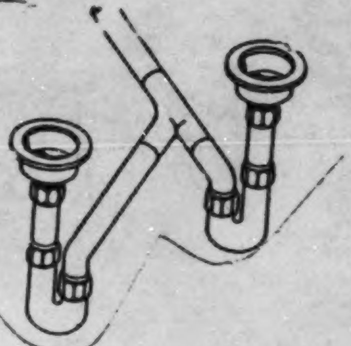
Types Of Drainage Connections

(Continued)

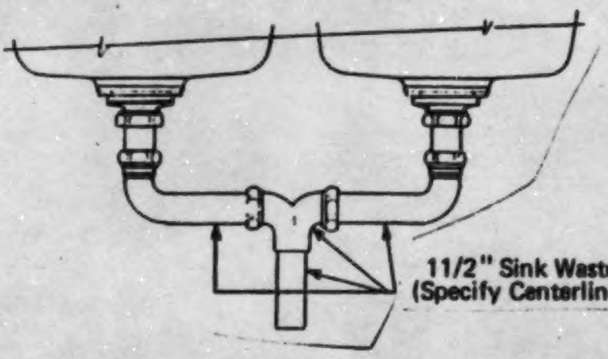
Kitchen Sink Traps And Wastes



Single Sink/Vanity

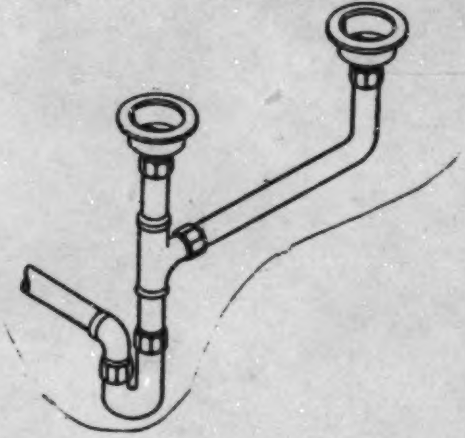


Single Waste-2 Traps



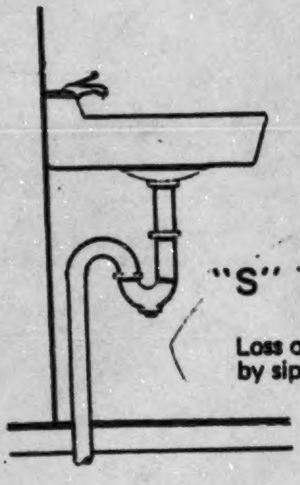
11/2" Sink Waste Slip Joint 2 Part-Center Outlet
(Specify Centerline Distance between Sink Outlets)

Double Sink Continuous Waste Center Outlet



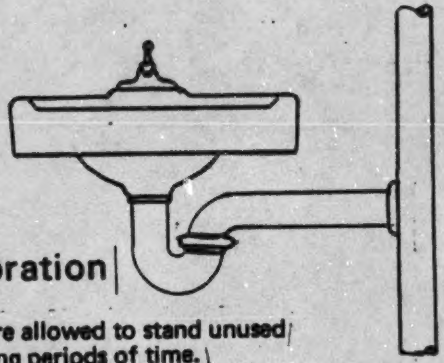
Continuous Waste End Outlet

Loss Of Trap Seal



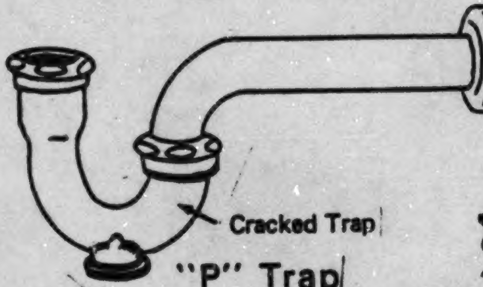
"S" Trap

Loss of trap seal by siphonage

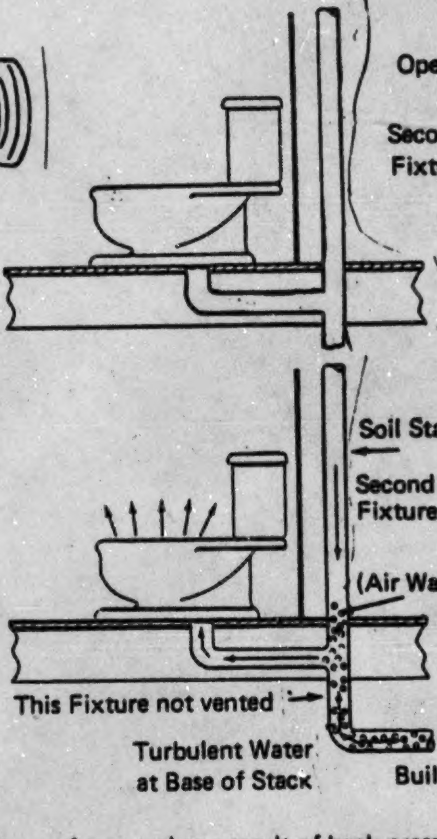


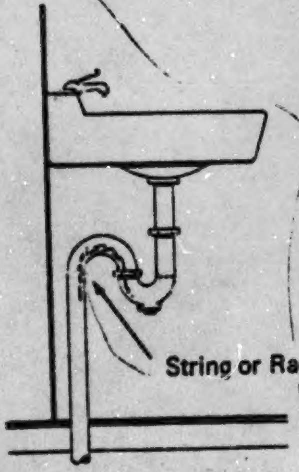
Evaporation

Fixture allowed to stand unused for long periods of time.


Cracked Trap

"P" Trap


Open Vent
Second Floor Fixture
Soil Stack
Second Floor Fixture Discharge
(Air Water Mixture)
This Fixture not vented
Turbulent Water at Base of Stack
Building Drain


String or Rag

Loss of trap seal by capillary action.

Loss of trap seal as a result of back pressure.

DRAINAGE CONNECTIONS
UNIT III

JOB SHEET #1–INSTALL A CAST IRON WATER CLOSET FLANGE

EVALUATION--Given access to tools, equipment, and materials, install a cast iron water closet flange. Evaluation will include use of correct methods, safety precautions, and general appearance of the job.

I. Tools and equipment

- A. Cast iron water closet flange
- B. Stub of 4" cast iron pipe

  (NOTE: Secure pipe in position to receive flange. Top of pipe should be even with or slightly below finished floor level.)

- C. Caulking tools and equipment
  1. Furnace and propane tank
  2. Yarning iron
  3. Packing iron
  4. Caulking irons
  5. Flooring iron
  6. Lead pot
  7. Ladle
  8. Oakum
  9. Lead
  10. Hammer
- D. Clean cloth
- E. Safety glasses

II. Procedure

- A. Gather all the tools and equipment and carry to the job site

  (NOTE: Instructor should emphasize safety precautions while working with lead.)

P-85-F

JOB SHEET #1

B. Set up the propane tank and furnace in a safe place near the job

C. Put on safety glasses

D. Place lead pot on furnace and light furnace

(NOTE: Cut up manageable pieces of lead with flooring chisel and place in lead pot.)

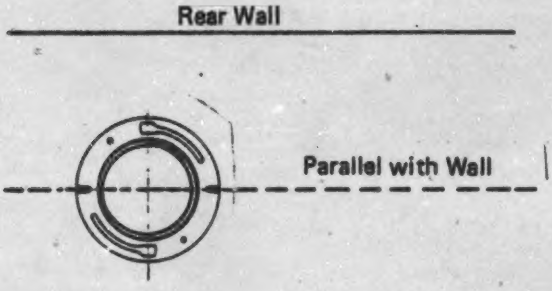
E. Cut several strands of oakum into workable lengths, 27"-30"

F. Clean floor around water closet drainpipe

G. Place water closet flange on pipe and line up holes (Figure 1)

(NOTE: Flanges are available in various depths.)

FIGURE 1



H. Place the ladle on the furnace to warm up

I. Yarn the oakum into the fitting and tighten with the packing iron

(NOTE: Allow 1" for lead.)

J. Pour lead, in one pour, into fitting

(CAUTION: Fitting and oakum must be dry to avoid steam explosion.)

K. Return extra lead to pot and shut off furnace

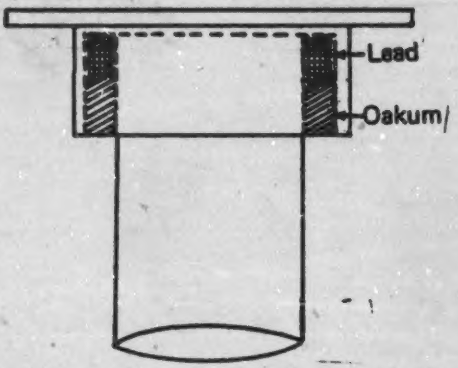
86-F

JOB SHEET #1

L. Caulk lead into the fitting using inside and outside irons (Figure 2)

(NOTE: Throughout the whole process, keep the flange in line.)

FIGURE 2



M. Install the water closet

(NOTE: Refer to Unit IV, Fixtures and Appliance Installation.)

N. Put all tools and equipment away

(CAUTION: Use care in handling hot furnace and lead pot.)

O. Clean up the work site

P. Check with instructor for evaluation of job

P-81-F

DRAINAGE CONNECTIONS
UNIT III

JOB SHEET #2--INSTALL A PLASTIC WATER CLOSET FLANGE

EVALUATION--Given access to tools, equipment, and materials, install a plastic water closet flange. Evaluation will include use of correct methods, safety precautions used, and general appearance of the job.

I. Tools and equipment

   A. Plastic closet flange

   B. Available stub of 3" plastic P.V.C.

   (NOTE: Stub should be roughed-in at the correct height to take the adapter.)

   C. P.V.C. cleaner with brush

   D. P.V.C. solvent cement with brush

   E. 6' rule

   F. Medium size screwdriver

   G. 4 #8 - 1-1/2" wood screws

   H. Hand drilling machine and 1/8" drill

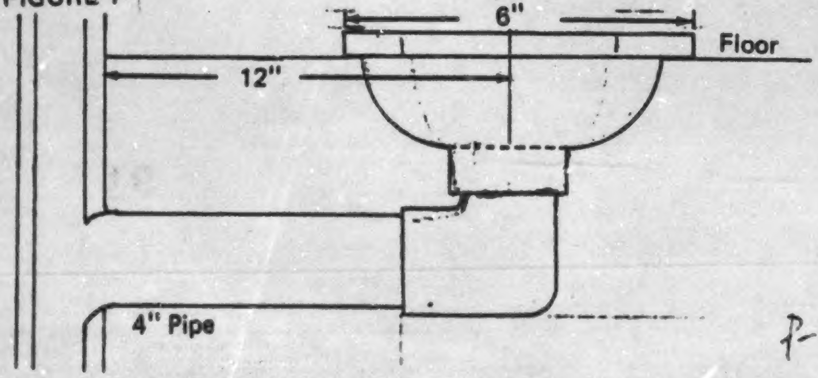
II. Procedure

   A. Gather all the tools and equipment and carry to the job site

   B. Measure closet flange to be sure it will fit flush on the finished floor (Figure 1)

   (NOTE: Holes should be cut to allow flange to be secured to floor with screws.)

FIGURE 1



P-5-1-F

JOB SHEET #2

C. Clean pipe and flange with the cleaner

(NOTE: Clean only those parts to be cemented.)

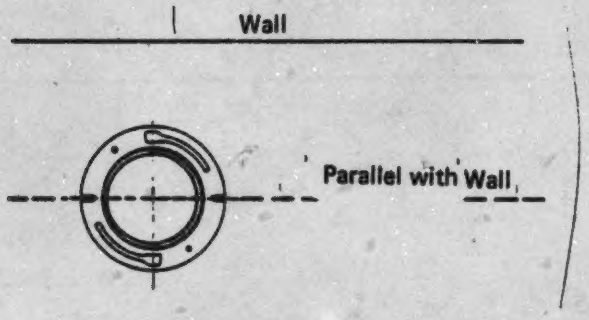
D. Apply cement to pipe and closet flange

(NOTE: This part of job must be done quickly because the cement hardens in a few seconds.)

E. Quickly push the flange into the pipe and twist to line up closet bolt holes (Figure 2)

(NOTE: Make sure flange rests on floor.)

FIGURE 2



F. Drill holes into floor and screw flange to floor

G. Put tools and equipment away and clean up the area

H. Check with instructor for evaluation of job

90-F

JOB SHEET #3--INSTALL A BRASS TO COPPER PIPE WATER CLOSET FLANGE

EVALUATION-- Given access to tools, equipment, and materials, install a copper water closet flange. Evaluation will include use of correct methods, safety precautions, and general appearance of the job.

I. Tools and equipment

   A. Closet flange

   B. Torch and tank outfit

   C. Striker

   D. Solder

   E. Flux with brush

   F. Sandcloth

   G. Clean cloth

   H. Hand drilling machine and 1/8" drill

   I. Four #8 1 1/2" wood screws

   J. Screwdriver (medium size)

   K. Round file

   L. Fire extinguisher

   M. Safety glasses

II. Procedure

   A. Gather all tools and equipment and carry to the job site

   B. Clean the pipe and flange with sandcloth

   (NOTE: Clean only those parts to be soldered.)

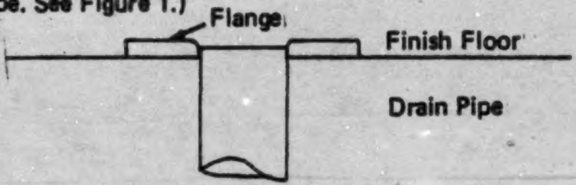
J-41-F

JOB SHEET #3

C. Apply flux to parts to be soldered

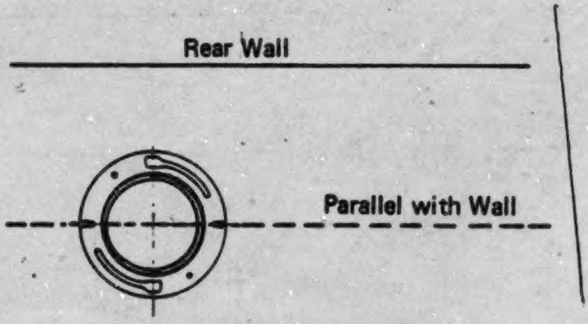
(NOTE: Copper drainpipe should have been roughed in to provide correct height of pipe. See Figure 1.)

FIGURE 1



D. Place flange on pipe and line up the closet bolt holes (Figure 2)

FIGURE 2



E. Put on safety glasses

F. Drill holes into floor and screw flange to floor

G. Light and adjust the torch

H. Apply heat and solder the flange and pipe from the inside

(CAUTION: This situation is a potential fire hazard; keep fire extinguisher handy.)

I. With a round file, remove any burrs on the pipe

J. Put all tools and equipment away and clean up the area

K. Check with instructor for evaluation of job

DRAINAGE CONNECTIONS
UNIT III

JOB SHEET #4--INSTALL A LAVATORY TRAP

EVALUATION--Given access to tools, equipment, and materials, install a lavatory trap. Instructor's evaluation will include use of safety precautions, correct methods used, accuracy of measurements, and general appearance. Trap should not leak when tested.

(NOTE: Lavatory should be hung on the wall with faucet and drain installed--See Unit IV, Fixture and Appliance Installation.)

I. Tools and equipment

(NOTE: Refer to local code.)

A. 1 1/2" chromed brass P trap with deep escutcheon

B. Lavatory with pop-up drain installed

C. 1 1/2" x 1 1/4" slip nut with washer

D. 6' rule or steel tape

E. 2" tubing cutters

F. Spud wrench or all-purpose wrench

G. Pipe compound

H. 1 1/2" P.V.C. straight male adapter

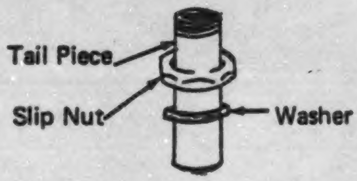
II. Procedure

A. Gather all tools and equipment and carry to job site

B. Open trap carton and inspect for missing parts

C. Place 1 1/4" x 1 1/2" slip nut and washer on lavatory drain tailpiece (Figure 1)

FIGURE 1

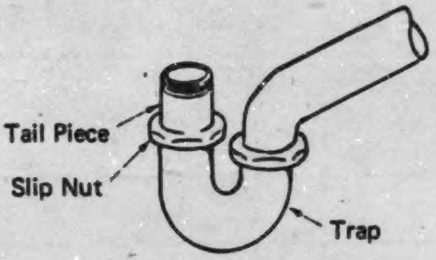


P-13-F

JOB SHEET #4

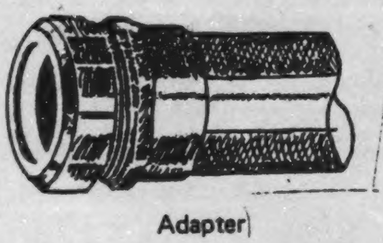
D. Place a small amount of pipe compound on the "J Bend" threads and attach "J Bend" to tailpiece slip nut (Figure 2)

FIGURE 2


Tail Piece
Slip Nut
Trap

E. Cut off P.V.C. drainpipe close to wall and cement on the male adapter (Figure 3)

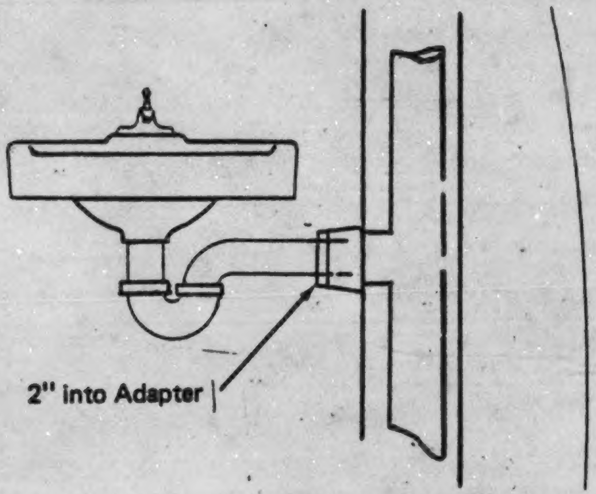
FIGURE 3



JOB SHEET #4

F. Measure the distance from the "J Bend" to the P.V.C. adapter and cut the trap discharge tube 2" longer than that measurement (Figure 4)

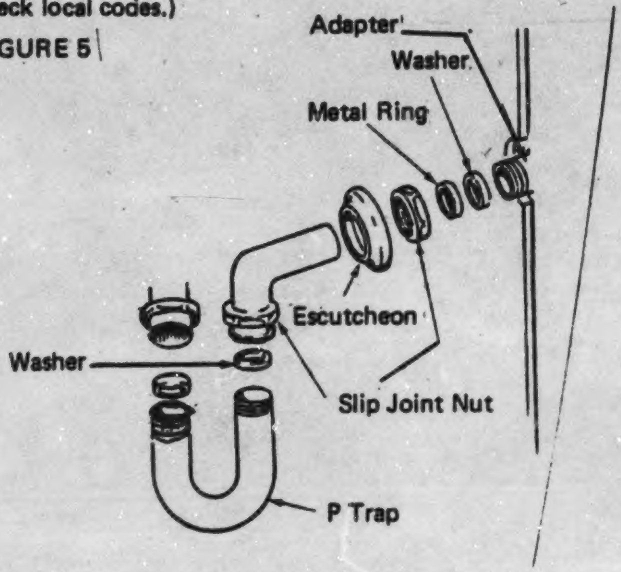
FIGURE 4


2" into Adapter

G. Apply pipe compound to P.V.C. adapter and make final connections (Figure 5)

(NOTE: Make sure escutcheon, slip nuts and washers are in proper order. Check local codes.)

FIGURE 5


Adapter
Washer
Metal Ring
Escutcheon
Washer
Slip Joint Nut
P Trap

H. Ask instructor for approval of job

I. Put tools and equipment away and clean up the area

DRAINAGE CONNECTIONS
UNIT III

JOB SHEET #5--INSTALL A KITCHEN SINK TRAP

EVALUATION--Given access to tools, equipment, and materials, install a kitchen sink trap. Instructors evaluation will include use of safety precautions, correct methods used, accuracy of measurements, and general appearance. Trap should not leak when tested.

(NOTE: Faucet, basket strainer, and sink should already be installed.)

I. Tools and equipment

   A. 1 1/2" tubular P trap

   B. 1 1/2" continuous waste

   C. 2 - 1 1/2" tailpieces

   (NOTE: The length is to be determined by instructor.)

   D. 2" tubing cutters

   E. Spud wrench or all-purpose wrench

   F. Pipe dope

II. Procedure

   A. Gather all tools and equipment and carry to the job site

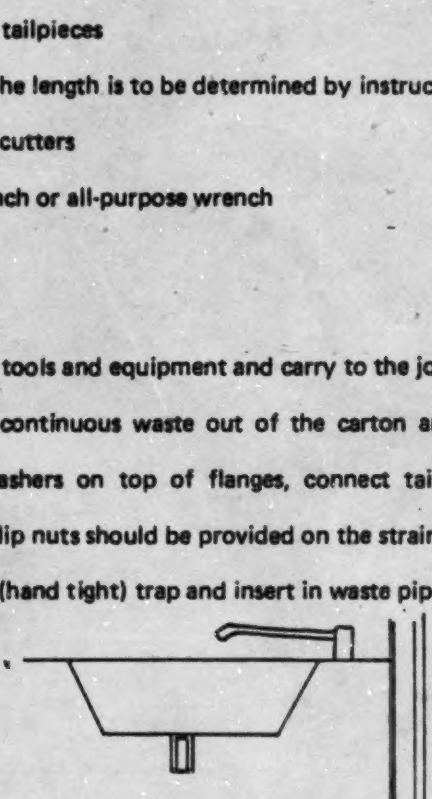
   B. Take the continuous waste out of the carton and check for missing parts

   C. Placing washers on top of flanges, connect tailpieces to basket strainers

   (NOTE: Slip nuts should be provided on the strainers.)

   D. Assemble (hand tight) trap and insert in waste pipe drain (Figure 1)

FIGURE 1



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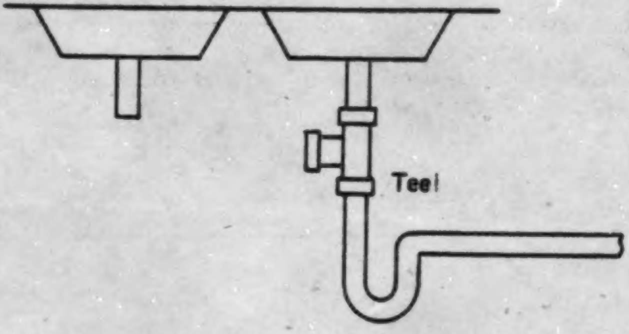
JOB SHEET #5

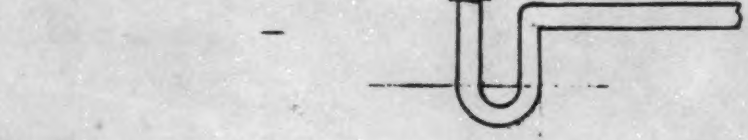
E. Connect (hand tight) continuous waste T to tailpiece nearest the trap (Figure 2)

FIGURE 2



F. Connect (hand tight) continuous waste extension drain to other tailpiece (Figure 3)

FIGURE 3

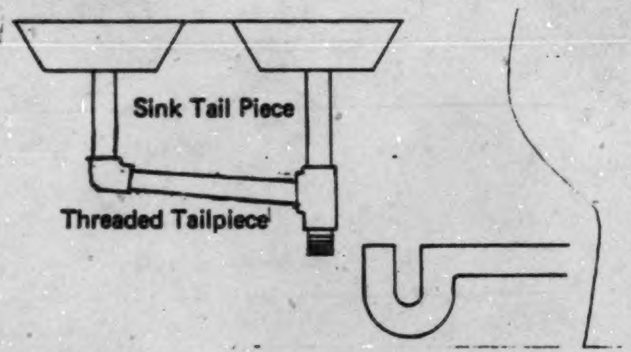


G. Mark extension piece to fit T socket and cut with tubing cutters

JOB SHEET #5

H. Place small amount of pipe dope on continuous waste tailpiece and screw into bottom of "T" (Figure 4)

FIGURE 4



I. Swing trap around to connect tailpiece, but do not connect

(NOTE: Measure length of tailpiece needed to make trap connection. Sink tailpieces may need to be shortened.)

J. Cut trap to correct length

(NOTE: Line up cutter on tube carefully or the cutting wheel will "track" out spiral grooves.)

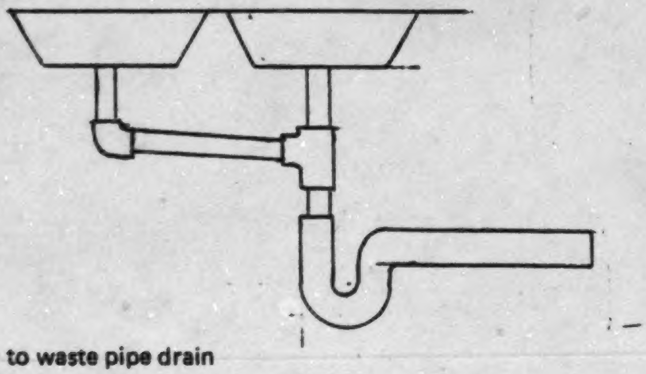
K. Remove trap and continuous waste and disassemble

L. Apply small amount of pipe dope to all threaded parts and reassemble

M. Place continuous waste on sink tailpieces and connect using slip nuts and washers

N. Connect trap to continuous waste tailpiece (Figure 5)

FIGURE 5



O. Connect trap to waste pipe drain

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DRAINAGE CONNECTIONS
UNIT III

JOB SHEET #6--INSTALL A BRASS TO LEAD PIPE WATER CLOSET FLANGE

EVALUATION: Given access to tools, equipment, and materials, install a brass closet flange for a lead soil pipe connection. Evaluation will include use of correct methods, safety precautions used, and general appearance of the job.

I. Tools and equipment

- A. Closet flange
- B. Torch and tank outfit
- C. Striker
- D. Solder
- E. Flux and brush
- F. Sandcloth
- G. Clean cloth
- H. Hand drilling machine and 1/8" drill
- I. Four #8 - 1 1/2" wood screws
- J. Medium screwdriver
- K. Round file
- L. Ball peen hammer
- M. Hacksaw
- N. Tin snips
- O. Pocket knife
- P. Safety glasses
- Q. Fire extinguisher

P-101-F

JOB SHEET #6

II. Procedure

(NOTE: Wear safety glasses for soldering jobs.)

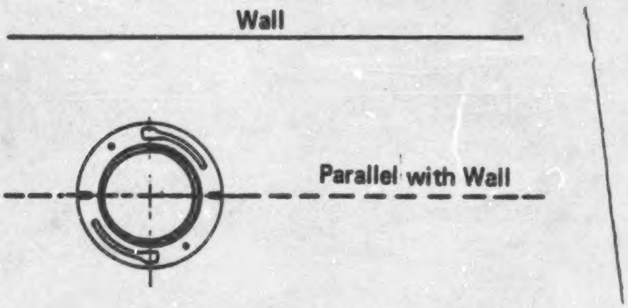
A. Gather all tools and equipment and carry to the job site

B. Clean the pipe flange with sandcloth

(NOTE: Clean only that part to be soldered.)

C. Place flange over pipe and line up the closet bolt holes (Figure 1)

FIGURE 1



D. Drill holes through screw holes into floor

E. Screw flange to floor using screwdriver and wood screws

F. Using a hacksaw, cut the lead pipe off just above the floor

G. With the ball peen hammer, peen lead pipe over to meet the brass flange

(NOTE: If necessary, trim the lead pipe with the tin snips.)

H. Clean the edge of the lead pipe with a pocket knife or scraper to prepare the surface for soldering

(NOTE: The edge of the lead pipe should line up with the ring of the flange to be soldered.)

I. Apply flux to the flange and lead pipe

(NOTE: Apply only to that portion which is to be soldered.)

JOB SHEET #6

J. Solder the connection being careful to apply the flame only to the brass flange and not the lead pipe

(CAUTION: This job is a potential fire hazard; keep fire extinguisher handy.)

K. Wipe the soldered connection to remove excess flux and, if necessary, smooth the edge of the lead pipe

L. Check with instructor for evaluation of job

M. Clean up the area and return all tools and equipment

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DRAINAGE CONNECTIONS
UNIT III

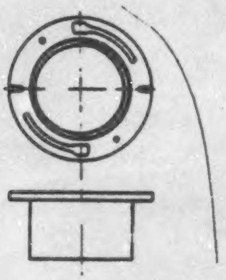
NAME ______________________

TEST

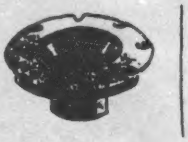
1. Match the terms on the right to the correct definitions or descriptions.

_____a. A recessed strainer fitting into the drain outlet of a sink	1. Plumber's putty
_____b. Movement of liquid upward through cellular structure of fibrous strands or through structure of other solids	2. Evaporation
_____c. Loss of water (especially in a drainage trap) to the atmosphere	3. Basket strainer
_____d. Rubber seal used around stems of some valves to prevent water from leaking out	4. Seal of a trap
_____e. A soft prepared mixture used to seal sink rims, drain outlets, and other places where a sealant is needed	5. Capillary attraction
_____f. Depth of water held in a trap under normal operating conditions	6. O-ring

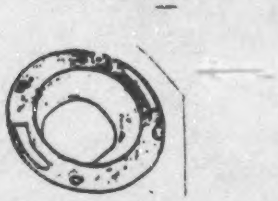
2. Identify various drainage connections used in residential plumbing.



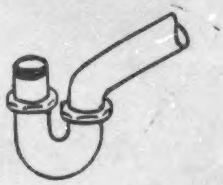
a. ______________________



b. ______________________

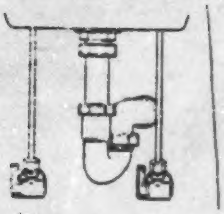


c. ______________________

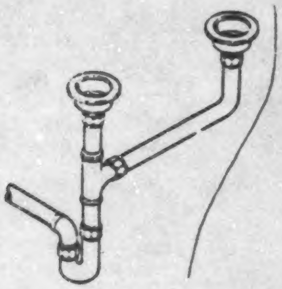


d. ______________________

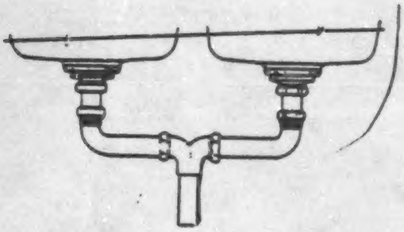
P-100-F



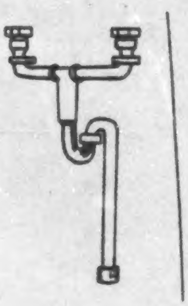
e. ____________________



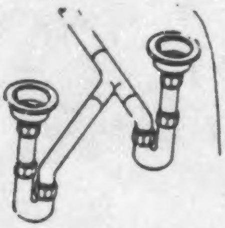
f. ____________________



g. ____________________



h. ____________________



i. ____________________

3. List four ways a trap can lose its seal.

   a.

   b.

   c.

   d.

4. Demonstrate the ability to:
   - a. Install a cast iron water closet flange.
   - b. Install a plastic water closet flange.
   - c. Install a brass to copper pipe water closet flange.
   - d. Install a lavatory trap.
   - e. Install a kitchen sink trap.
   - f. Install a brass to lead pipe water closet flange.

   (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

DRAINAGE CONNECTIONS
UNIT III

ANSWERS TO TEST

1. a. 3
   b. 5
   c. 2
   d. 6
   e. 1
   f. 4
2. a. Cast iron water closet flange
   b. PVC water closet flange
   c. Brass water closet flange
   d. "P" trap
   e. Single sink/vanity
   f. Continuous waste-end outlet
   g. Continuous waste-center outlet
   h. "S" Trap
   i. Single waste - 2 traps
3. Any four of the following:
   a. Evaporation
   b. Capillary attraction
   c. Siphonage
   d. Leaks
   e. Back pressure
4. Performance skills evaluated to the satisfaction of the instructor.

FIXTURES AND APPLIANCES
UNIT IV

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with fixtures and appliances, identify various types of fixtures and appliances, and select true statements about construction methods and materials. The student should also be able to match specific fixtures and appliances with their correct installation requirements and install fixtures and appliances. This knowledge will be evidenced by correctly performing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with fixtures and appliances to the correct definitions.
2. Identify the common fixtures and appliances used in residential plumbing.
3. Match fixtures and appliances with correct installation requirements.
4. Select true statements about the construction and materials used in the manufacture of common fixtures and appliances.
5. Demonstrate the ability to:
    - a. Install a water closet (floor mount).
    - b. Install a lavatory (wall hung type).
    - c. Install a bathtub (5' recessed).
    - d. Install shower bath accessories in a ceramic tile bathroom.
    - e. Install an electric water heater.
    - f. Install a dishwasher.
    - g. Install a garbage disposal unit.
    - h. Install a gas water heater.

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FIXTURES AND APPLIANCES
UNIT IV

SUGGESTED ACTIVITIES

[illegible]

- [illegible] student with objective sheet.
- [illegible] student with information and job sheets.
- [illegible] ansparencies.
- [illegible] unit and specific objectives.
- [illegible] information sheets.
- [illegible] strate and discuss the procedures outlined in the job sheets.
- [illegible] relative materials from fixture and appliance manufacturers.
- [illegible] a field trip to a residential construction site (coordinate with [illegible] ng contractor).
- [illegible].

[illegible]

- [illegible] objective sheet.
- [illegible] nformation sheet.
- [illegible] job sheets.
- [illegible].

INSTRUCTIONAL MATERIALS

[illegible] is unit:

- [illegible] ve sheet
- [illegible] ion sheet
- [illegible] ency masters
  - [illegible] 1--Water Closets - Bidets
  - [illegible] 2--Lavatories
  - [illegible] 3--Baths and Showers

    4. TM 4--Kitchen Sinks
    5. TM 5--Gas Water Heater
    6. TM 6--Electric Water Heater
    7. TM 7--Garbage Disposers, Dishwashers, Laundry Trays

D. Job sheets

    1. Job Sheet #1--Install a Water Closet (Floor Mount)
    2. Job Sheet #2--Install a Lavatory (Wall Hung Type)
    3. Job Sheet #3--Install a Bathtub (5' recessed)
    4. Job Sheet #4--Install Shower Bath Accessories in a Ceramic Tile Bathroom
    5. Job Sheet #5--Install an Electric Water Heater
    6. Job Sheet #6--Install a Dishwasher
    7. Job Sheet #7--Install a Garbage Disposal Unit
    8. Job Sheet #8--Install a Gas Water Heater

E. Test

F. Answers to test

II. Reference--Blankenbaker, E. Keith. *Modern Plumbing.* South Holland, IL: Goodheart-Willcox, 1978.

III. Additional reference--*Apprentice Training Presentation-Garbage Disposers.* Training Department, In-Sink-Erator Division, Emerson Electric Co., Ohio and 21st Streets, Racine, Wisconsin.

FIXTURES AND APPLIANCES
UNIT IV

INFORMATION SHEET

I. Terms and definitions

A. Plumbing fixture--A receptical for wastes which are ultimately discharged into the drainage system

B. Plumbing appliance--A special class of plumbing fixture intended to perform a special function

C. Backing--Wood or other support placed in the building walls to which plumbing fixtures can be attached

D. Bathtub--Water receptacle shaped to facilitate the entire body for bathing

E. Bidet--A low set bowl equipped with hot and cold running water which is used especially for bathing the internal and external genitals and posterior parts of the body

F. Dishwasher--An electric appliance for washing dishes

G. Drainage fixture unit (DFU)--A common measure of the probable discharge into the drainage system by various types of a plumbing fixtures on the basis of one DFU being equal to 7.5 gallons per minute of discharge

(NOTE: The drainage fixture unit value for a particular fixture depends on its volume rate of drainage discharge, on the duration of a single drainage operation, and on the average time between operations.)

H. Fixture drain--The drain from the trap of a fixture to the junction of that drain with any other pipe

I. Fixture supply--A water supply pipe connecting the fixture with the fixture branch pipe

J. Fixture branch--A water supply pipe between the fixture supply pipe and a water distribution pipe

K. Flood level rim--The top edge of plumbing fixture or receptical from which the water overflows

L. Flush--To wash out with a large amount of water

M. Garbage disposal--An electric grinding device used with water to grind food wastes and discharge these wastes into the drainage system

INFORMATION SHEET

N. Half-bath--A bathroom containing a water closet and lavatory

O. Kitchen sink--A shallow flat bottom fixture that is used in the kitchen for cleaning dishes and in the preparation of certain food

P. Laundry tray--A fixed tub installed in a laundry room of a home; it is supplied with cold and hot water and a drain connection, and is used for washing clothes and other household items

Q. Lavatory--A fixture designed for washing the hands and face; it is commonly found in bathrooms and restrooms

R. Three-quarter bath--A bathroom containing a water closet, lavatory, and a shower bath

S. Water closet--A water flushed plumbing fixture designed to receive human excrement directly from the user of the fixture

(NOTE: The term is sometimes used to describe the room or compartment in which the fixture is located.)

T. Wall-hung--Refers to a plumbing fixture which is supported from a wall

U. Vanity--A bathroom fixture consisting of a lavatory set into or onto the top of a cupboard or cabinet

V. Full bath--A bathroom containing a water closet, lavatory, and bathtub

II. Fixtures and appliances in residential plumbing

A. Water closets (Transparency 1)

1. Floor-set with close-coupled tank and bowl
2. One piece floor-set tank and bowl combination
3. Wall-hung siphon jet with close-coupled tank and bowl

B. Lavatories (Transparency 2)

1. Self rimming vanity lavatory
2. Rim-type vanity lavatory
3. Under-counter vanity-lavatory
4. Wall-hung lavatory

C. Baths (Transparency 3)

1. Recessed bathtub
2. Bath-shower modules

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INFORMATION SHEET

D. Shower baths (Transparency 3)

   1. Shower enclosures

   2. Shower bases

      (NOTE: Walls are built-in using a variety of materials.)

E. Bidets (Transparency 1)

F. Kitchen sinks (Transparency 4)

   1. Self rimming

   2. Rim-type

G. Water heaters (Transparencies 5 and 6)

   1. Gas

   2. Electric

H. Garbage disposers (Transparency 7)

I. Dishwashers (Transparency 7)

J. Laundry trays (Transparency 7)

   1. Floor model

   2. Wall-hung model

III. Installation requirements for fixtures and appliances

(NOTE: Refer to local codes.)

A. Water closets

   1. Rated at 6 DFU

   2. Requires a minimum of 3" for drain pipe

   3. Requires a minimum of 2" for vent pipe

   4. Has trap as an integral part of the fixture

      (NOTE: The trap is built into the water closet and needs no external additions.)

   5. Has a built-in flushing device

      (NOTE: The built-in flushing device needs no external water fitting.)

INFORMATION SHEET

B. Lavatories

1. Rated at 1 DFU
2. Requires a minimum of 1 1/4" for drain pipe
3. Requires a minimum of 1 1/4" for vent pipe
4. Requires a trap connection to the waste pipe
5. Requires a water fitting to deliver water into the lavatory

C. Bathtubs

1. Rated at 2 DFU
2. Requires a minimum of 1 1/2" for drain pipe
3. Requires a minimum of 1 1/2" for vent pipe
4. Requires a water fitting to deliver water into the tub
5. Requires a trap and overflow connection to the waste pipe

D. Shower baths

1. Rated at 2 DFU
2. Requires a minimum of 2" for drain pipe
3. Requires a minimum of 1 1/2" for vent pipe
4. Requires a trap connection to the waste pipe
5. Requires a water fitting to deliver water to the shower bath

E. Bidets

1. Rated at 2 DFU
2. Requires a minimum of 1 1/2" for drain pipe
3. Requires a minimum of 1 1/4" for vent pipe
4. Requires a trap connection to the waste pipe
5. Requires a water fitting to deliver water to the nozzle
6. Has vacuum breaker on water supply

INFORMATION SHEET

F. Kitchen sinks

1. Rated at 2 DFU
2. Requires a minimum of 1 1/2" for drain pipe
3. Requires a minimum of 1 1/2" for vent pipe
4. Requires a trap connection to the waste pipe
5. Requires a water fitting to deliver water to the sink

G. Water heaters

1. Most common fuels are gas and electricity
2. Usually constructed to heat and store water
3. Usually constructed so the controls operate automatically

H. Garbage disposers

1. Rated at 2 DFU
   - (NOTE: This figure is usually not added to the unit load of the kitchen sink piping.)
2. Usually installed directly below kitchen sink in place of the basket strainer
3. Requires a trap connection to the waste pipe
4. Requires kitchen sink water supply to provide adequate flushing of the drain
5. Requires electrical connection

I. Dishwashers

1. Rated at 2 DFU
2. Requires a minimum of 1 1/2" for drain pipe
3. Requires a minimum of 1 1/4" for vent pipe
4. Most dishwashers use a built-in pump to discharge waste water
5. Most dishwashers have built-in automatic water controllers
6. Requires a trap connection to the waste pipe or disposer

J. Laundry trays

1. Rated at 2 DFU
2. Requires a minimum of 1 1/2" drain pipe
3. Requires a minimum of 1 1/4" vent pipe
4. Requires a fitting to deliver water to the laundry trays
5. Requires a trap connection to the waste pipe

IV. Construction and materials used in the manufacture of fixtures and appliances

A. Water closets

1. Made by casting clay, flintstone and other materials which, having been combined in a semi-liquid state, are poured into molds to produce vitrous china

   (NOTE: In the rough stage, the water closet is made in sections due to difficulty of casting the trap and flushing compartments in one piece.)

2. Water closets are glazed and fired in a kiln at high heat for up to three days to ensure strength and quality of finish

3. Water closets are generally made in two sections--bowl and tank

   (NOTE: Some models integrate the bowl and the tank into one casting.)

4. Tanks are equipped with separately installed flushing mechanisms

5. Water closet seats are manufactured in colors to match the water closet

   (NOTE: Water closet seats are constructed with closed front for residential use and open front for public use.)

B. Lavatories

1. Vitreous china
2. Enameled cast iron
3. Enameled pressed steel
4. Stainless steel
5. Plastic
6. Fiberglass

C. Baths

1. Materials
    - a. Enameled steel
    - b. Enameled cast iron
    - c. Fiberglass
2. Construction
    - a. Bath bottoms should have a 1/8" per ft. pitch toward the drain
    - b. Available in various sizes, shapes, and colors

      (NOTE: Recessed tubs are the most common and are made in 4 1/2', 5', and 5 1/2', lengths.)
    - c. Height of the flood rim varies between 13" and 16"

D. Shower baths

1. Materials
    - a. Base
        - 1) Terrazzo
        - 2) Fiberglass
        - 3) Cast stone
        - 4) Enameled steel
    - b. Walls
        - 1) Fiberglass
        - 2) Enameled steel
        - 3) Glazed tile
        - 4) Patented waterproof sheeting
2. Construction
    - 1. 30" x 30"
    - 2. 36" x 36"
    - 3. 36" x 48"
    - b. Lead-pan sub bases are made on-the-job from sheet lead and can be made in any floor size necessary

INFORMATION SHEET

E. Bidets

1. Made of vitreous china to afford clean washdown

   (NOTE: Bidets are only intended for washing the body.)

2. Usually located next to the water closet

3. Installed directly on the floor similar to a floor mounted water closet

F. Kitchen sinks

1. Materials

   a. Enameled cast iron

   b. Enameled pressed steel

   c. Stainless steel

2. Available in various capacities

   a. Single well (compartment)

   b. Double well

   c. Triple well

G. Water heaters

1. Most water heaters are steel tanks with bonded glass linings intended to prevent corrosion of the tank

   (NOTE: Solar heaters are rapidly becoming popular.)

2. Tank is insulated and covered with enameled steel jackets

3. Automatic controls are actuated by a thermostat

   (NOTE: Desired temperature can be predetermined by a manual control.)

4. Water heaters are constructed with three pipe openings in the top

   a. Cold water inlet

      (NOTE: Also contains the dip tube which carries the cold water to the bottom of the tank.)

   b. Hot water outlet

      (NOTE: Some water heaters incorporate magnesium anode rods into the hot water outlet to prevent electrolytic deterioration of the water heater.)

c. Relief valve opening

(NOTE: Relief valves should be temperature-pressure actuated.)

5. In the event that no opening is provided for a relief valve, most codes require that the valve be placed in the hot water line within six inches of the tank

   (NOTE: Refer to local codes.)

6. Water heaters are constructed with drain valves (boiler drains) at the bottom of the water tank

7. A drip line should extend from the relief/temperature valve to within 12" of the floor

8. Gas water heaters

   a. Need gas piping connections

      (NOTE: Some local codes allow flexible connectors at the heater.)

   b. Need an exhaust flue to the outside atmosphere

      (NOTE: Flues should be as large as the exhaust outlet on the heater.)

   c. Water heaters and furnaces may use the same chimney if the heat flue enters the chimney above the furnace flue

      (NOTE: Check for combustion error.)

   d. Connecting directly to a furnace flue is permitted if a Y connection is used

      (CAUTION: Never use a T connection.)

   e. Black iron pipe and fittings should be used for the gas piping

   f. A shutoff valve (gas cock) should be installed in the gas line close to the heater

   g. A union should be installed close to the heater for easy installation and removal of heater

   h. Manufacturer's instructions should be used for lighting and adjusting gas burners

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INFORMATION SHEET

9. Electric water heaters

   a. Need no flue connection

   b. Use an insulated heating element

   c. Some heaters have two heating elements

      1) Lower element for normal use

      2) Upper element when larger amounts of hot water are required

   d. Heaters are wired for 240 volts

      (NOTE: 120 volt heaters are available but are not as efficient as 240 volts.)

   e. Electrical work should be done by a licensed electrician

      (CAUTION: Electrical connections should not be made until water heater has been filled with water.)

H. Garbage disposers

1. Four main components

   a. Electric motor

   b. Grinding chamber

   c. Two grinding elements

      1) Rotating shredder

      2) Stationary grind ring

   d. Sink fitting

2. Operates on 120 volts

3. Made of stainless steel, plastic or other materials

4. Easily installed in place of sink basket strainer and tailpiece

   (NOTE: Follow specific manufacturer's instructions for installation.)

5. Most disposers have a dishwasher drain connection

INFORMATION SHEET

I. Dishwashers

1. Self-contained units which need water and waste connections

   (NOTE: Follow specific manufacturer's instructions for installation.)

2. Many types and models manufactured using various methods, design, and materials

   (NOTE: Plumbers should become acquainted with various models offered by manufacturers.)

J. Laundry trays

1. Most are made of fiberglass, cast iron, or plastic
2. Double compartment and single compartment models are available
3. Floor models (with legs) and wall-hung models are available

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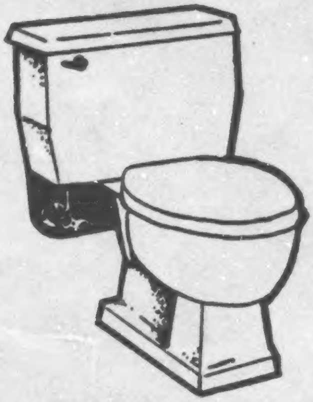
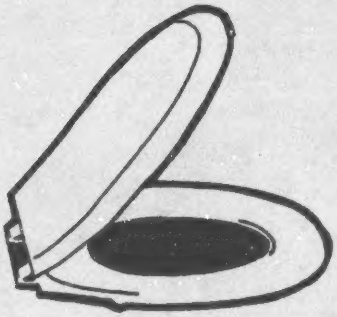
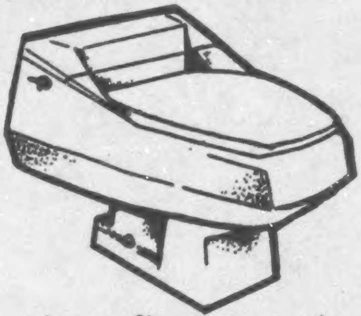
Water Closets-Bidets



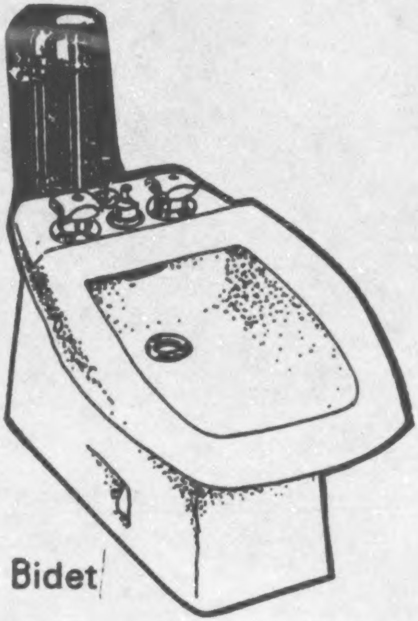
Floor set closet with close-coupled tank and bowl.



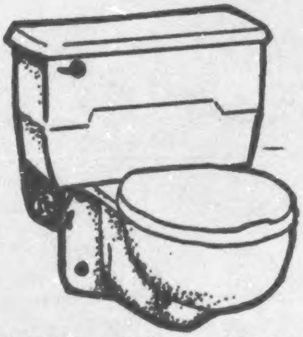
Closed front seat and cover .



One-piece floor set closet tank and bowl combination.

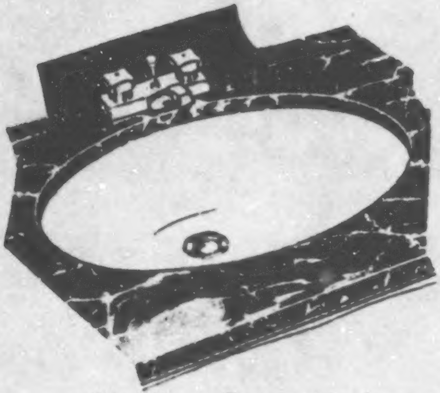


Bidet

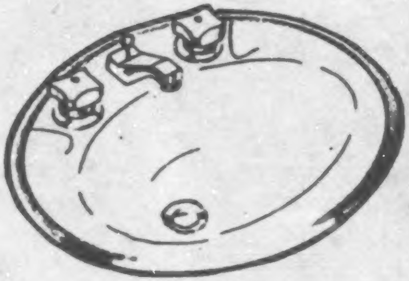


Wall-hung siphon jet water closet with a close-coupled tank and bowl.

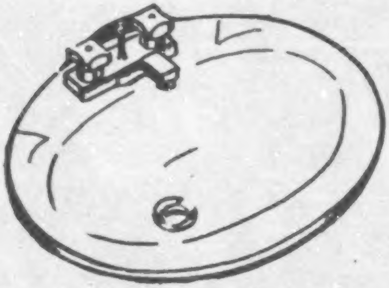
Lavatories



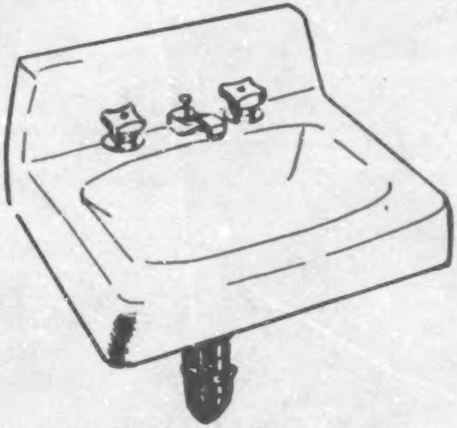
Under-Counter
Vanity Lavatory



Rim-Type
Vanity Lavatory

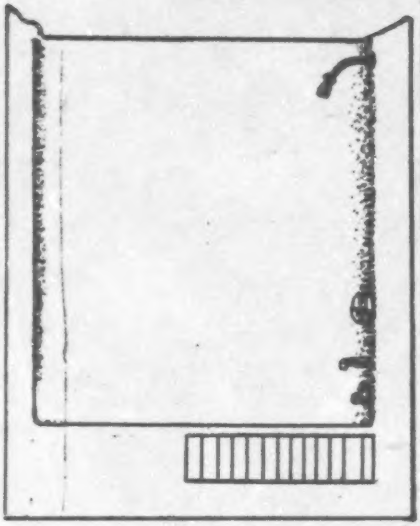


Self-Rimming
Vanity Lavatory

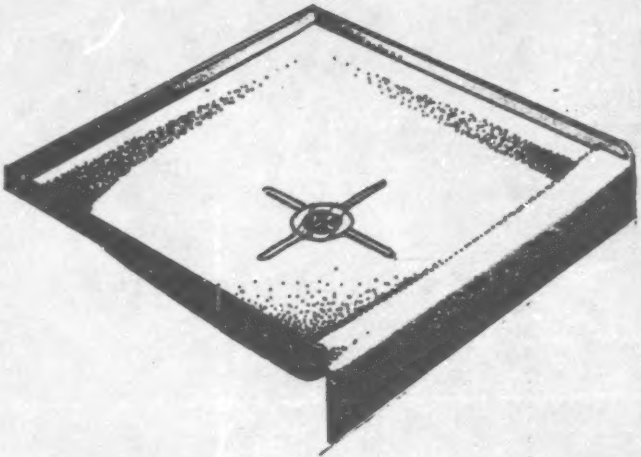


Wall Hung Lavatory
with Raised Back

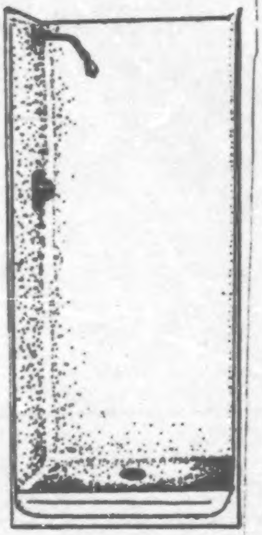
Baths and Showers



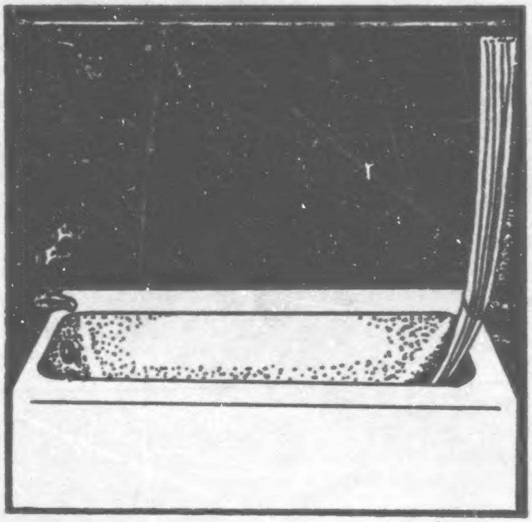
Bath-shower Module



Fiberglass Shower Base

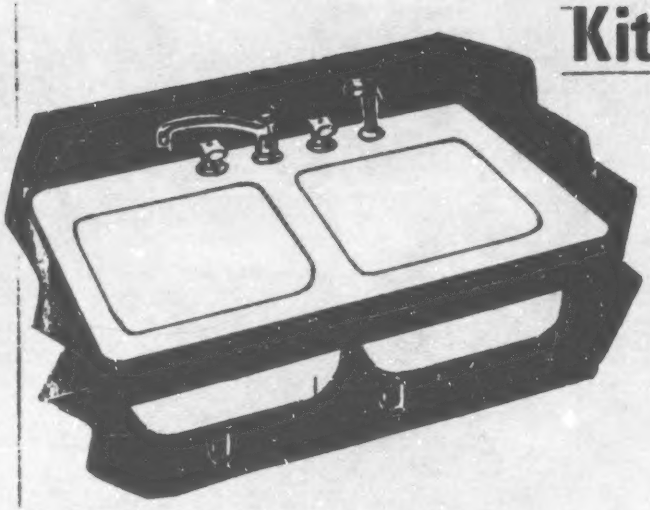


One-piece Fiberglass
Shower Enclosure

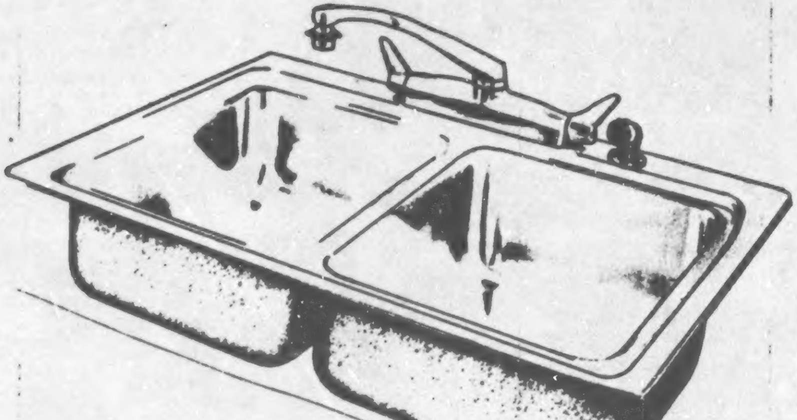


Recessed Bathtub

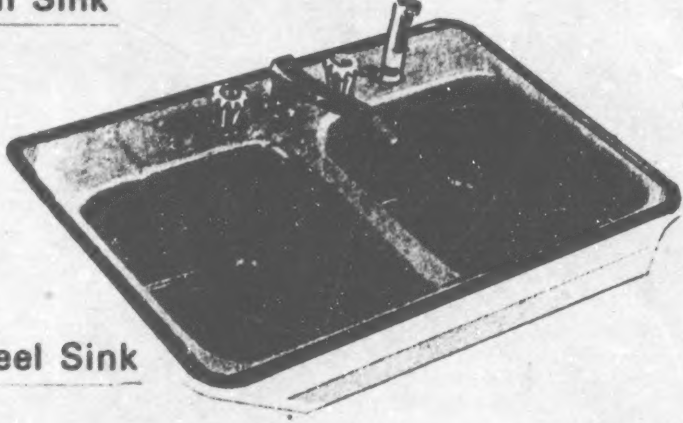
Kitchen Sinks



Self-rimming Enameled Cast Iron Sink

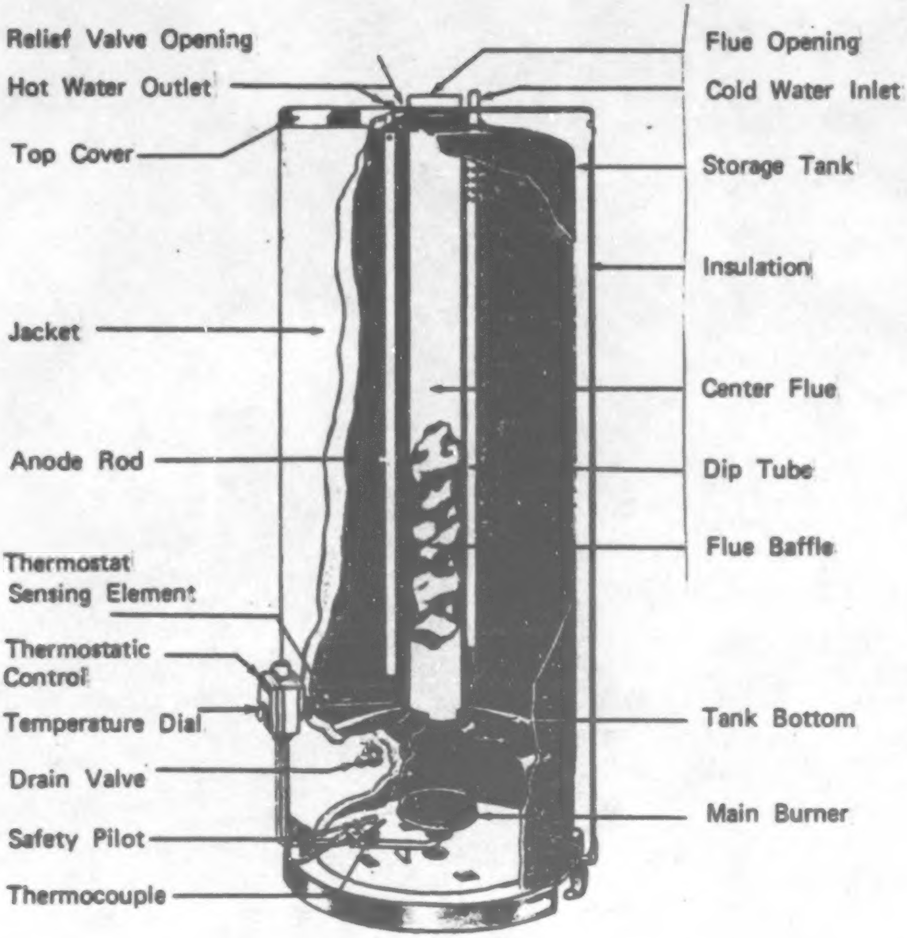


Rim-type Enameled Cast Iron Sink



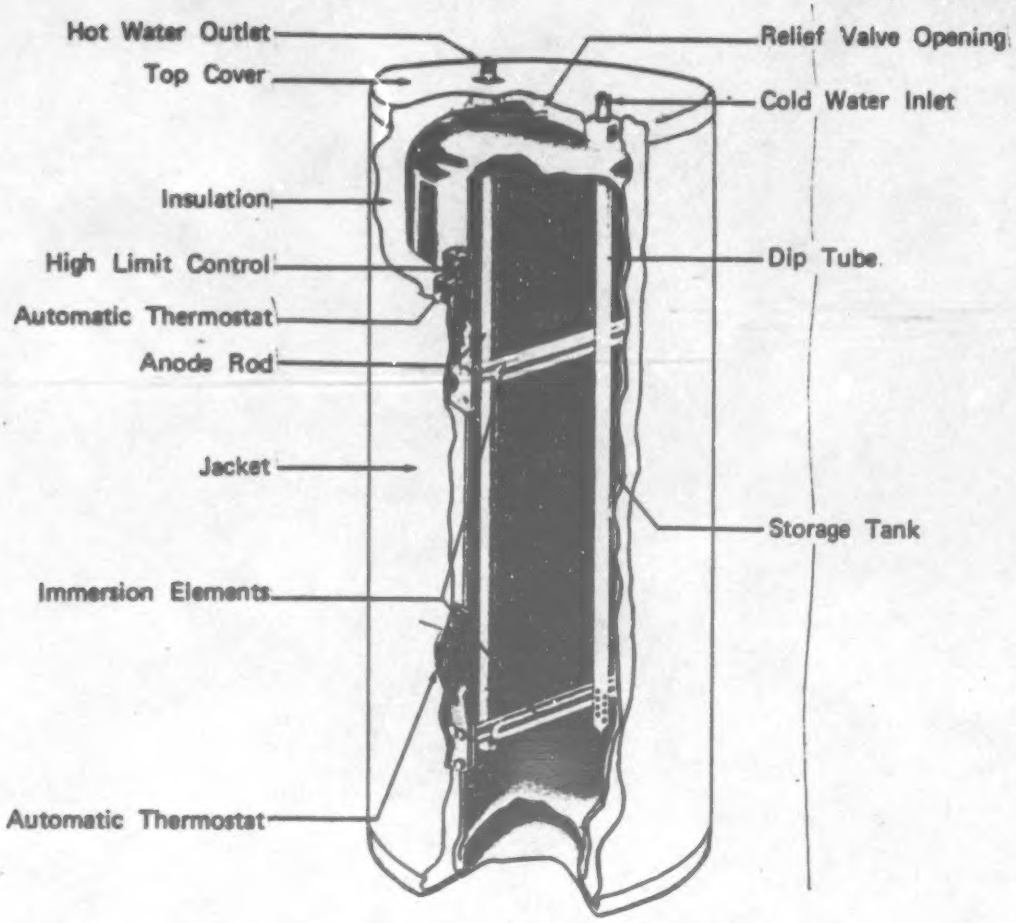
Stainless Steel Sink

Gas Water Heater


Relief Valve Opening
Hot Water Outlet
Top Cover
Jacket
Anode Rod
Thermostat Sensing Element
Thermostatic Control
Temperature Dial
Drain Valve
Safety Pilot
Thermocouple
Flue Opening
Cold Water Inlet
Storage Tank
Insulation
Center Flue
Dip Tube
Flue Baffle
Tank Bottom
Main Burner

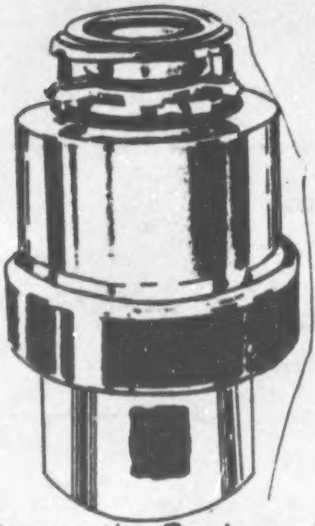
Sectional View of an
Automatic Gas Storage Tank Water Heater
(A.O. Smith)

Electric Water Heater


Hot Water Outlet
Top Cover
Insulation
High Limit Control
Automatic Thermostat
Anode Rod
Jacket
Immersion Elements
Automatic Thermostat
Relief Valve Opening
Cold Water Inlet
Dip Tube
Storage Tank

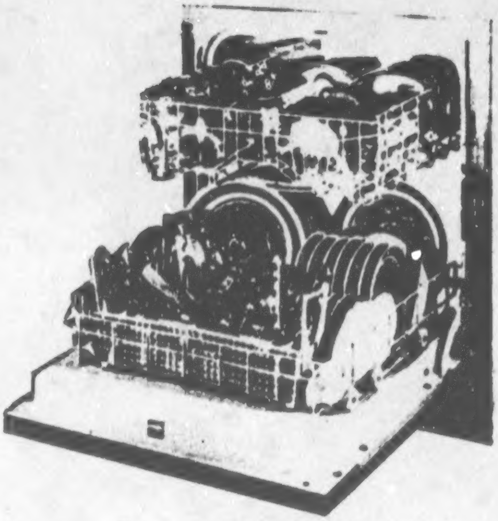
Sectional View Of an Automatic
Electric Storage Tank Water Heater.
(A.O. Smith)

Garbage Disposers



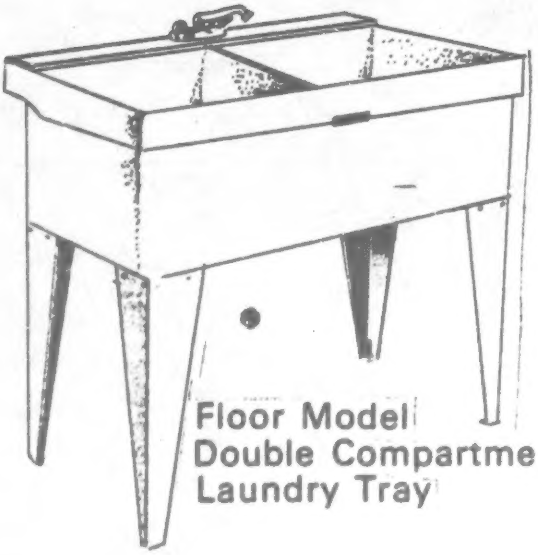
Domestic Garbage Disposal

Dishwasher

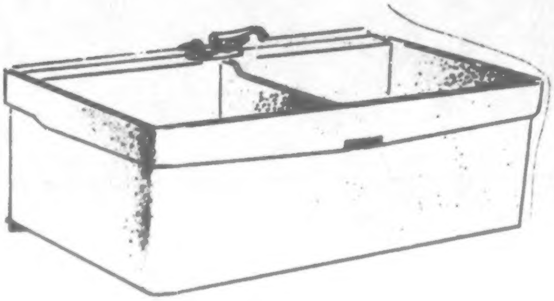


Domestic Dishwasher

Laundry Trays



Floor Model Double Compartment Laundry Tray



Wall-Hung Double Compartment Laundry Tray

FIXTURES AND APPLIANCES
UNIT IV

JOB SHEET #1--INSTALL A WATER CLOSET (FLOOR MOUNT)

EVALUATION: Given access to tools, equipment, and materials install a floor mount water closet. The instructor will evaluate the job for leaks, neatness, and levelness.

I. Tools and equipment

   A. Water closet (complete bowl and tank)

   B. Water closet seat

   C. Wax seal

   D. Closet bolts (with bolt caps)

   E. Closet supply pipe (with angle valve)

   (NOTE: Determine type of pipe connection before acquiring closet supply.)

   F. Closet flange (w/screws if wood floor)

   G. 6 ft. ruler

   H. Pencil

   I. Cloth or rag

   J. Hacksaw (jab saw type preferred)

   K. Tubing cutters

   L. 8" adjustable wrench

   M. Pipe joint compound

   N. Large straight screwdriver

   O. Socket wrench or water closet seat wrench

   P. Necessary tools to install closet flange (soldering outfit, caulking tools, or plastic pipe tools)

   Q. 2' level

   R. Drop cloth

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JOB SHEET #1

II. Procedure

A. Gather all tools and equipment and carry to the work site

B. Install the water supply angle valve

C. Install the water closet flange on the soil pipe if not previously done

D. Remove wax seal from wrapper or carton and place on water closet bowl outlet

(NOTE: Place firmly to avoid having the seal move when positioning the water closet bowl.)

E. Position the closet bolts in the closet flange

F. Carefully lift water closet bowl, turn right side up, and place over closet flange centering bolt holes over bolts

G. With a slight rocking motion, force the bowl down on the wax seal until the bowl sets evenly on the floor

(NOTE: In cold weather, the wax ring may have to be warmed before installation.)

H. Check the bolt caps and if any clips are necessary on the bolts, install them now

I. Place washers and nuts on bolt ends and hand tighten

J. Place a level on the bowl (parallel to the back wall) and tighten bolts

(NOTE: Shims may be necessary to level the bowl.)

K. Remove water closet tank from carton

(NOTE: Check for missing parts.)

L. Place washers on tank bolts and insert down through bolt holes

(NOTE: Check parts list for correct and complete assembly.)

M. Straddle the water closet bowl and carefully place tank on bowl, allowing the bolts to enter the bolt holes in the bowl

N. Hold bolt heads (usually provided with screwdriver slot) with one hand and place washer and nut on end of each bolt

(NOTE: Sit on bowl facing tank.)

O. With large screwdriver, hold bolt heads (in tank) and tighten nuts (under tank) with adjustable wrench or socket wrench

(NOTE: Place level on top of tank and adjust bolts accordingly.)

P. Measure and cut the water supply tube

(NOTE: Allow for any bends needed.)

1. Hand tighten the supply tube to the ballcock shank
2. Make necessary bends
3. Determine length of supply tube and make scratch mark
4. Remove supply tube and cut to desired length

Q. Install the water supply tube using a small amount of pipe joint compound on threaded connections; this acts as a lubricant and creates a tighter joint

(NOTE: Hold ballcock with one hand while tightening shank connection.)

R. If not previously done, secure angle valve in final position

(NOTE: This may be soldered, compression joint, or threaded.)

S. Install seat, using socket wrench or W.C. seat wrench

T. Check closet bolts (flange) for tightness

U. Cut closet bolts off to desired height and install bolt caps

V. Check tank bolts for tightness

W. Turn on water and check for leaks

1. Packing gland on angle valve
2. Under tank
3. Supply tube
4. Base of bowl

X. Adjust float arm for desired water level

(NOTE: If required, grout the base of the water closet bowl.)

Y. Clean up area and put tools away

(NOTE: Clean any tools that have accumulated dirt, water, and/or pipe compound.)

Z. Check with instructor for approval of installation

FIXTURES AND APPLIANCES
UNIT IV

JOB SHEET #2--INSTALL A LAVATORY (WALL HUNG TYPE)

EVALUATION: Provided with the rough-in plumbing and access to tools, equipment and supplies, install a wall-mounted lavatory. The lavatory must be installed in a level and sturdy position. Chrome fittings and faucets must not be scarred. Fitting joints must not leak, and water must drain freely.

I. Tools and equipment

- A. 6' ruler
- B. Pencil
- C. 2' level
- D. Hand drilling machine
- E. 3/8" masonry drill
- F. 3/16" twist drill
- G. Basin wrench
- H. 8" adjustable wrench
- I. Tubing cutters: 1/2", 1 1/2"
- J. Pipe joint compound
- K. Medium size screwdriver
- L. Spud wrench or all purpose wrench
- M. Plug wrench
- N. 6 wood screws (for lavatory hanger)
- O. 1 1/2" P-trap (chrome plated brass tube, 17 gauge)
- P. Faucet (complete and with drain plug)
- Q. Set of flexible supply tubes with angle valves
- R. Lavatory (wall hung type)
- S. Grout

F-14 F

JOB SHEET #2

II. Procedure

A. Gather all tools and equipment and carry to the work site

B. Make sure the wall and floor of the work area are clean

C. Lay out tools in an orderly fashion and within easy reach

D. Take lavatory out of carton and make sure wall hanger is not missing

(NOTE: Use care in handling. Scratches could mean replacing the lavatory.)

E. On bathroom wall, determine and lightly mark exact location (center line) of installation (Figure 1)

(NOTE: Center line of lavatory is usually (but not always) directly above drain stub.)

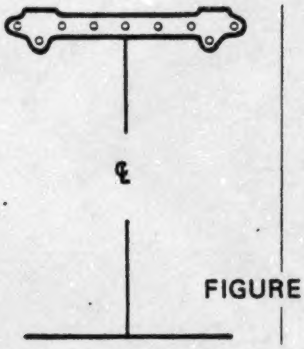

FIGURE 1

F. Determine hanger height from floor (Figure 2)

(NOTE: This measurement is sometimes provided on manufacturer's rough-in sheets.)

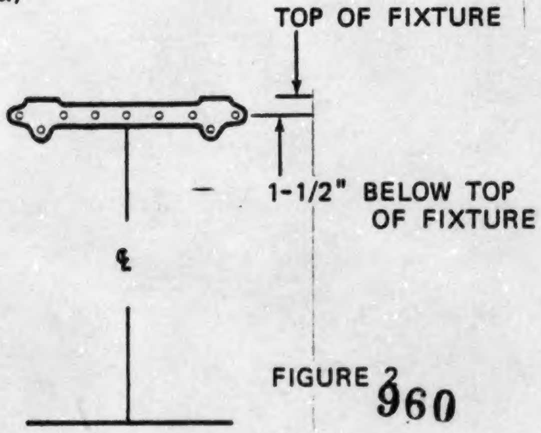

FIGURE 2

JOB SHEET #2

G. Hold the hanger on the wall at the proper height and locate center screw hole on vertical center line (Figure 3)

(NOTE: Level the hanger with the 2' level.)

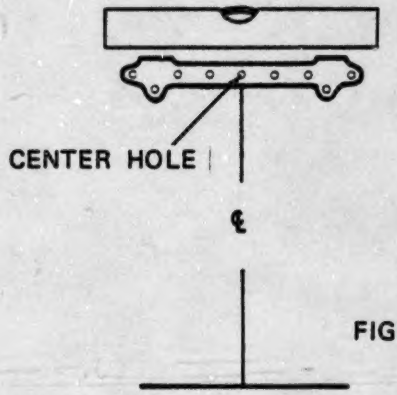

FIGURE 3

H. Mark proposed screw locations on the wall

I. Remove hanger

(NOTE: Accuracy in drilling holes is important.)

J. Start holes in glazed tile by chipping the glaze off with a nail set

K. Drill screw starter holes

(NOTE: Tile and cement walls should be drilled with a masonry drill and wood backing should be drilled with a twist drill. If wood backing has not been installed, nylon anchors, molly bolts or toggle bolts are acceptable in some cases. Usually legs are provided for the lavatory in such cases. See Figure 4.)

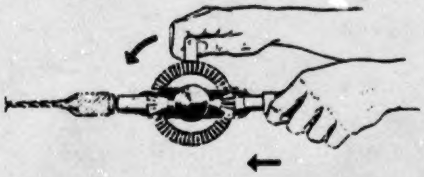

FIGURE 4

J. Install the faucet and drain plug according to manufacturer's instructions

(NOTE: Refer to Unit II--WATER VALVES AND FAUCETS.)

K. Place lavatory on hanger, lightly tap downward with the heel of the hand, and check with a 2' level

(NOTE: Lavatory should seat firmly on the hanger.)

L. Install water supply angle valve

(NOTE: Refer to Unit II--WATER VALVES AND FAUCETS.)

M. Connect supply tube to faucet shank (hand tight) (Figure 5)

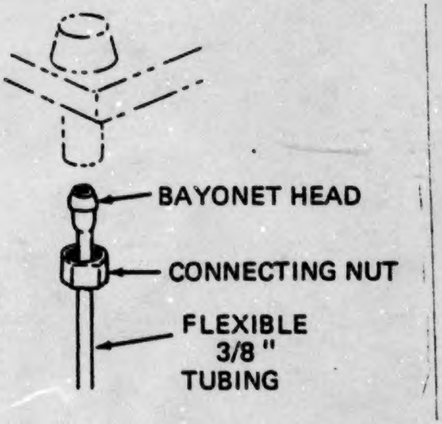

FIGURE 5

N. Make necessary bends in supply tube and make scratch mark at desired length

(NOTE: Check for fitting allowance in the angle valve.)

O. Remove supply tube and cut to desired length

P. Place shank and angle valve nuts on supply tube and secure tube in position

(NOTE: A basin wrench is necessary to make a tight connection on the shank end.)

JOB SHEET #2

Q. Install trap

(NOTE: Refer to Unit III--DRAINAGE CONNECTIONS. See Figure 6.)

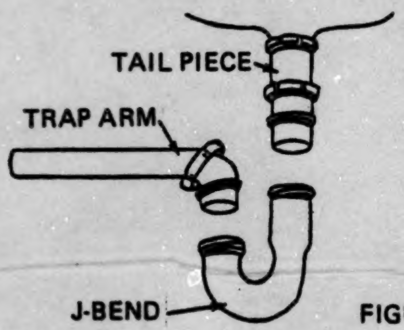
TAIL PIECE
TRAP ARM
J-BEND

FIGURE 6

R. Clean up area and return tools

S. Check with instructor for approval of installation

FIXTURES AND APPLIANCES
UNIT IV

JOB SHEET #3--INSTALL A BATHTUB (5' RECESSED)

EVALUATION: Given access to tools, equipment and materials, install a 5' recessed bathtub. The instructor will evaluate the job for neatness, levelness and firmness of installation.

I. Tools and equipment

   A. Bathtub (recessed, 5')

   B. Tub waste and overflow

   C. Trap

   D. 1" x 4" x 4' lumber

   E. Newspapers or other tub protection material

   F. 6' rule

   G. Pencil

   H. Long-handled broom

   I. Handsaw

   J. Hammer

   K. Nails (approximately one dozen, 10d or 16d)

II. Procedure

   A. Gather all tools and equipment and carry to the worksite

   B. Sweep out tub space

   (NOTE: All trash should be removed and the floor made clean and smooth.)

   C. Uncrate the tub being careful not to cause scratches

   (NOTE: On cast iron tubs, two men should handle the installation.)

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JOB SHEET #3

D. Determine the distance from the floor to the underside of the rear ledge (Figure 1)

(NOTE: This measurement is usually not given on manufacturer's specifications.)

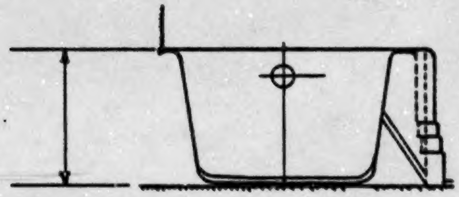

FIGURE 1

TUB-END VIEW

E. Pencil mark this distance on each end stud of the back wall (Figure 2)

(NOTE: Measure vertically, from the floor.)

F. If necessary, cut 1" x 4" lumber to fit tub opening

G. Nail 1" x 4" lumber across studs, using the pencil mark as the upper edge

(NOTE: The 1" x 4" ledge now represents the distance from floor to the underside of the rear ledge of the tub.)

H. Carefully bring the tub into the tub space and rest the rear ledge on the 1" x 4" support

I. Level the tub (length and width) using vinyl shims if necessary

(NOTE: The tub should rest firmly on the ledge and the floor.)

J. If made of enameled steel, secure the tub to the rear studs with shingle nails

(NOTE: Cast iron tubs need not be fastened down.)

K. Completely cover the tub with protective materials

(NOTE: The bathroom may not be finished for weeks after this installation, and because of the large number of workers in the building, damage could occur to the tub if not protected.)

L. Clean up the area and put tools away

(NOTE: Clean any tools that may have become wet or dirty.)

M. Check with instructor for evaluation of job

FIXTURES AND APPLIANCES
UNIT IV

JOB SHEET #4--INSTALL SHOWER BATH ACCESSORIES IN A CERAMIC TILE BATHROOM

EVALUATION: Given the rough-in plumbing and tool set, including strap wrench, install shower bath accessories in a ceramic tile bath. Completed work must be approved by the instructor.

I. Tools and equipment

   A. Strap wrench

   B. Pipe wrench

   C. Phillips head screwdriver

   D. Shower bath accessories

   E. Pipe compound

   F. Clean cloth

II. Procedure

   A. Gather all tools and equipment and carry to job site

      (NOTE: Protect the tub from possible damage due to falling tools.)

   B. Remove test nipple and cap from shower pipe elbow using pipe wrench

   C. Connect shower head and arm and slide escutcheon over arm

   D. Apply pipe compound to threaded portion of shower arm and install arm in shower pipe elbow

      (NOTE: Tighten only with strap wrench to avoid scratching chrome finish.)

   E. Move escutcheon to fit tightly to wall

   F. Remove protective coverings from bath-shower valves

   G. Install escutcheons and valve covers

      (NOTE: Keep escutcheons tight to wall.)

   H. Install valve handles, tightening screws with screwdriver

JOB SHEET #4

I. Snap on screw-head covers

J. Wipe valves and tub with clean cloth

K. Check with instructor for approval of the job

L. Clean up area and return tools to proper place

FIXTURES AND APPLIANCES
UNIT IV

JOB SHEET #5--INSTALL AN ELECTRIC WATER HEATER

EVALUATION: Given the rough-in plumbing and access to plumbing tools, equipment, and supplies, install an electric water heater. All pipe joints must be leakproof.

I. Tools and equipment

   A. Tubing cutter with reamer

   B. Air-acetylene torch

   C. Striker

   D. Tank wrench

   E. Solder

   F. Flux

   G. Sand cloth

   H. Adjustable wrench

   I. Tubing

   J. Fittings as needed

   K. Relief valve

   L. Water heater

   M. 2 3/4" male adapters

   N. 1 3/4" gate valve

II. Procedure

   A. Gather all tools and equipment and carry to the job site

   B. Remove water heater from the carton

   C. Assemble soldering tools and solder 2, 3/4" male adapters onto 2, 8" pieces of 3/4" copper tubing

   (NOTE: Allow to cool thoroughly before installing in tank.)

D. Apply pipe compound to threaded portion of relief valve and install valve in heater

(NOTE: Location is usually marked.)

E. Install tubing from relief valve to within 12" inches of the floor

(NOTE: See local code.)

F. Position heater in proper place for installation

(NOTE: Electric elements must be accessible.)

G. Apply pipe compound/tape to 3/4" male adapters and install in Inlet and outlet openings using adjustable wrench

(NOTE: Check local codes for reference to dielectric unions.)

H. Clean and flux 3/4" valve and tubing ends protruding from 3/4" male adapters

I. Install 3/4" valve on cold water inlet tubing

J. Clean and flux tubing for cold and hot water connections

K. Install tubing and make soldered connections

(NOTE: Open valve before soldering.)

L. Close drain valve

M. Open hot water faucet on nearest fixture

N. Open cold water inlet valve on water heater

(NOTE: When water runs freely from fixture faucet, close inlet valve.)

O. Check for leaks

(NOTE: when heater is first turned on, condensation may appear on the floor under the heater.)

P. Have instructor evaluate work

(NOTE: The job is now ready for the electrician.)

Q. Clean up the area and replace all tools and equipment

FIXTURES AND APPLIANCES
UNIT IV

JOB SHEET #6 --INSTALL A DISHWASHER

EVALUATION: Given a rough-in plumbing manufacturer's installation manual and access to plumbing tools, equipment, and supplies, install a dishwasher. The dishwasher drain connections to the kitchen sink and water supply line must not leak. The drain line must prevent backfill from the sink drain line.

I. Tools and equipment

   A. Air-acetylene torch

   B. Striker

   C. Gas tank

   D. Tank wrench

   E. Solder

   F. Flux

   G. Sand cloth

   H. Adjustable wrench

   I. Flaring tool and block

   J. Flare nut wrench

   K. Level

   L. Screwdriver

   M. 1/2" tubing cutters

   N. 1 1/2" tubing

   O. Tubing

   P. Fittings and valves

   Q. Dishwasher adapter sink tailpiece

   R. 6' rule or steel tape

   S. Clean cloth

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JOB SHEET #6

II. Procedure

(NOTE: Check manufacturer's specifications before proceeding.)

A. Remove front cover from dishwasher using screwdriver

B. Place dishwasher in position in the cabinet

C. Locate water inlet and outlet on dishwasher

D. Using adjustable wrench, install unions on inlet and outlet connections

(NOTE: Dishwashers must be able to be disconnected in order to be removed easily.)

E. Shut off hot water supply to kitchen sink and drain the line

F. Cut into hot water line under sink and install tee and valve to dishwasher

G. Run line from valve to water inlet on dishwasher and solder all connections

(NOTE: Check manufacturer's specifications.)

H. Remove tailpiece from sink drain nearest dishwasher and replace with dishwasher adapter tailpiece using spud wrench

I. Measure and cut 1/2" copper tubing to fit from drain union on dishwasher to adapter tailpiece on sink drain

(NOTE: Check manufacturer's specifications for drain loop to prevent sink backup into dishwasher.)

J. Clean and flux all connections

K. Install tubing and solder connections

L. Turn water on and check for leaks

(NOTE: Electrician must connect electricity in order to check all connections.)

M. Check manufacturer's instructions for securing dishwashers to cabinet and leveling legs

N. Replace front cover

O. Ask instructor to evaluate job

P. Return tools to proper place and clean up area

FIXTURES AND APPLIANCES
UNIT IV

JOB SHEET #7--INSTALL A GARBAGE DISPOSAL UNIT

EVALUATION: Provided a cabinet-mounted sink, a garbage disposal unit and appropriate tools and fittings, install a garbage disposal unit so that no joints leak.

I. Tools and equipment

   A. Adjustable spud wrench or all-purpose wrench

   B. Pipe compound

   C. Strainer wrench

   D. 2" tubing cutter

   E. Garbage disposal

II. Procedure

   A. Gather all tools and equipment and carry to the job site

   B. Remove garbage disposal unit from carton and read manufacturer's instructions

   C. Remove sink tailpiece using adjustable spud wrench

   D. Loosen basket strainer in sink using strainer wrench

   E. Position disposal unit under sink drain

   F. Screw basket strainer into top of disposal unit and tighten lock nut using strainer wrench

   G. Install continuous waste drain into disposal unit and tighten slip joints with adjustable spud wrench

   (NOTE: Use a directional (venturi) tee in the continuous waste drain.)

   H. Install trap between disposal unit and waste drain and tighten slip joints with adjustable spud wrench

   I. Turn on the water into sink and check for leaks

   J. Check with instructor for approval of job

   (NOTE: Electrician should make electrical connection.)

   K. Clean up the area and return tools to proper place

FIXTURES AND APPLIANCES
UNIT IV

JOB SHEET #8--INSTALL A GAS WATER HEATER

EVALUATION: Given the rough-in plumbing and access to plumbing tools, equipment and supplies, install a gas water heater. Finished work must be approved by the instructor.

I. Tools and equipment

- A. Water heater
- B. Relief valve
- C. Pipe
- D. Fittings and valves
- E. Vent pipe
- F. Pipe vise
- G. Pipe cutter
- H. Reamer
- I. Pipe threader
- J. Oil can
- K. Black iron pipe
- L. Gas pipe fittings and valves
- M. Drop cloth

II. Procedure

- A. Locate relief valve outlet on water heater
- B. Install relief valve
- C. Attach 3/4" approved line from relief valve to location of desired overflow

  (NOTE: End of line must not be threaded.)
- D. Using nipple, elbow and union, install 3/4" galvanized line from heater to cold water supply line
- E. Using nipple, elbow and union, install 3/4" galvanized line from heater to hot water supply line

JOB SHEET #8

F. Using 3" galvanized vent pipe, run vent into chimney

G. Using black iron pipe and fittings required, connect gas line to heater

H. Turn gas supply on and check for leaks, using soap and water solution as a leak detector

I. Open hot water faucet in kitchen sink

J. Turn water supply on

K. Fill hot water tank until water flows from hot water faucet in kitchen sink

L. Light and adjust burner

M. Check with instructor for approval of job

N. Clean up area and return tools to proper place

FIXTURES AND APPLIANCES
UNIT IV

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. A receptacle for wastes which are ultimately discharged into the drainage system

_____b. A special class of plumbing fixture intended to perform a special function

_____c. Wood or other support placed in the building walls to which plumbing fixtures can be attached

_____d. A water receptacle shaped to facilitate the entire body for bathing

_____e. A low set bowl equipped with hot and cold running water which is used especially for bathing the internal and external genitals and posterior parts of the body

_____f. An electric appliance for washing dishes

_____g. A common measure of the probable discharge into the drainage system by various types of plumbing fixtures on the basis of one DFU being equal to 7.5 gallons per minute of discharge

_____h. The drain from the trap of a fixture to the junction of that drain with any other pipe

_____i. A water supply pipe connecting the fixture with the fixture branch pipe

_____j. A water supply pipe between the fixture supply pipe and a water distribution pipe

_____k. The top edge of plumbing fixture or receptical from which the water overflows

1. Half-bath
2. Fixture drain
3. Bathtub
4. Three-quarter bath
5. Vanity
6. Plumbing fixture
7. Fixture branch
8. Flush
9. Bidet
10. Wall-hung
11. Kitchen sink
12. Dishwasher
13. Plumbing appliance
14. Fixture supply
15. Lavatory
16. Backing
17. Garbage disposal
18. Water closet
19. Drainage fixture unit (DFU)

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_____l. To wash out with a large amount of water

_____m. An electric grinding device used with water to grind food wastes and discharge these wastes into the drainage system

_____n. A bathroom containing a water closet and lavatory

_____o. A shallow flat bottom fixture that is used in the kitchen for cleaning dishes and in the preparation of certain food

_____p. A fixed tub installed in a laundry room of a home; it is supplied with cold and hot water and a drain connection, and is used for washing clothes and other household items

_____q. A fixture designed for washing the hands and face; it is commonly found in bathrooms and restrooms

_____r. A bathroom containing a water closet, lavatory, and a shower bath

_____s. A water flushed plumbing fixture designed to receive human excrement directly from the user of the fixture

_____t. Refers to a plumbing fixture which is supported from a wall

_____u. A bathroom fixture consisting of a lavatory set into or onto the top of a cupboard or cabinet

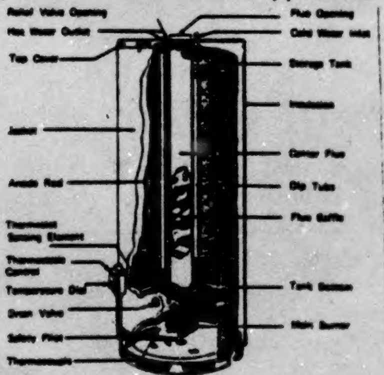
_____v. A bathroom containing a water closet, lavatory, and bathtub

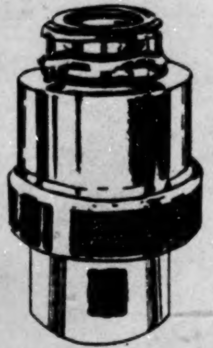
20. Laundry tray

21. Flood level rim

22. Full bath

2. Identify common fixtures and appliances used in residential plumbing.

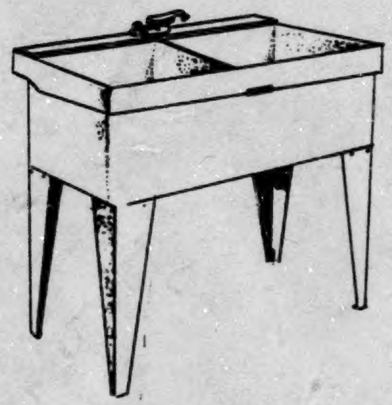

Relief Valve Opening
Hot Water Outlet
Top Cover
Jacket
Anode Rod
Thermostat Sensing Element
Thermostatic Control
Temperature Dial
Drain Valve
Safety Pilot
Thermocouple
Flue Opening
Cold Water Inlet
Storage Tank
Insulation
Center Flue
Dip Tube
Flue Baffle
Tank Bottom
Main Burner



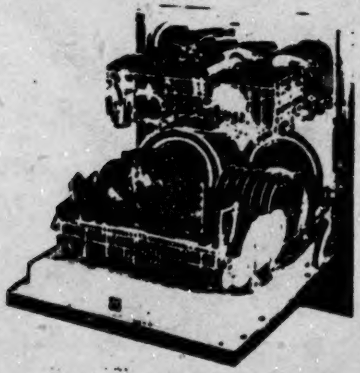
a. ______________________ b. ______________________

IIC-F

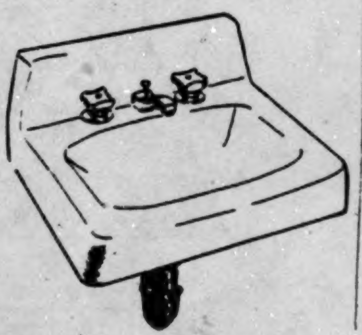
c. ______________________



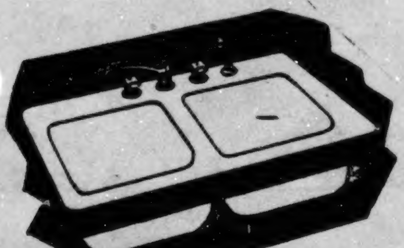
d. ______________________



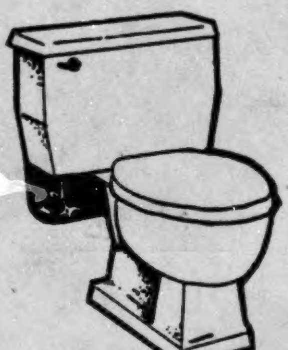
e. ______________________



f. ______________________



g. ______________________



h. ______________________

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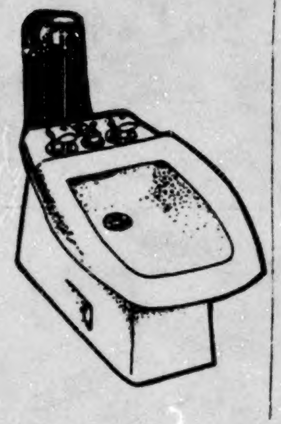
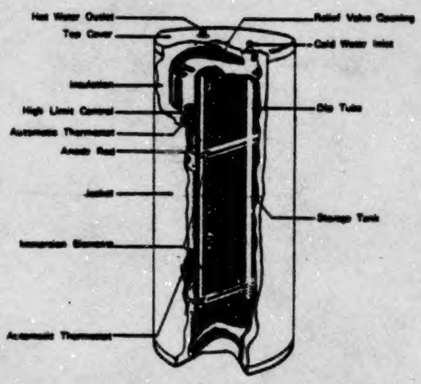
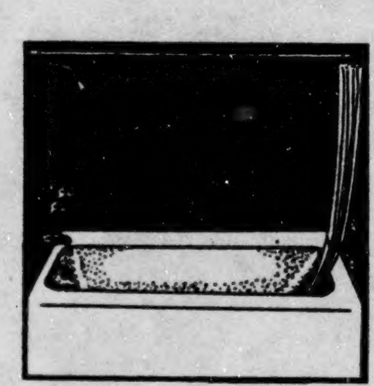


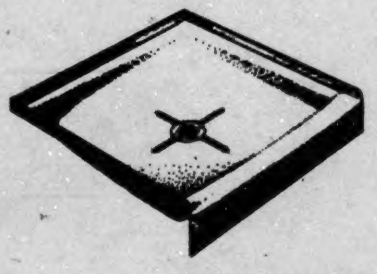
i. ____________________


Hot Water Outlet
Relief Valve Opening
Top Cover
Cold Water Inlet
Insulation
High Limit Control
Dip Tube
Automatic Thermostat
Anode Rod
Jacket
Storage Tank
Immersion Elements
Automatic Thermostat

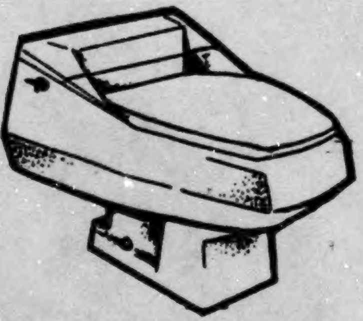
j. ____________________



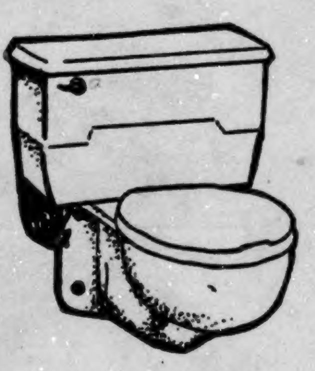
k. ____________________



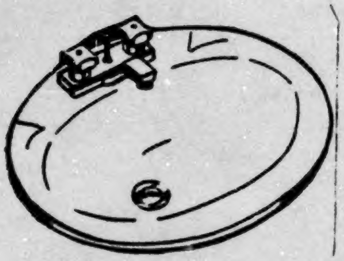
l. ____________________



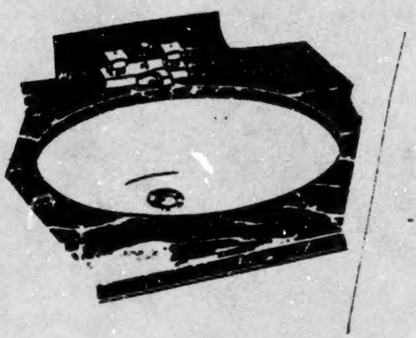
m. ____________________



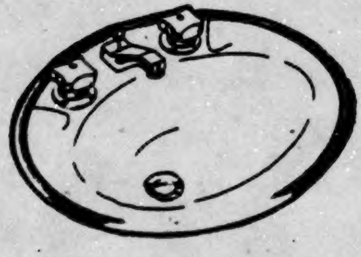
n. ____________________



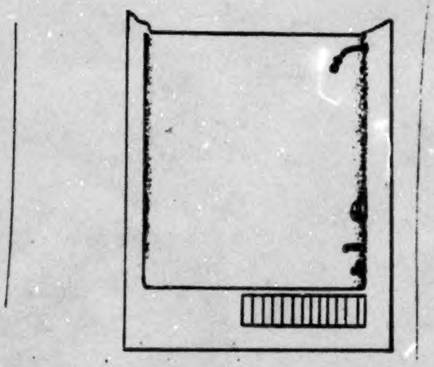
o. ______________________



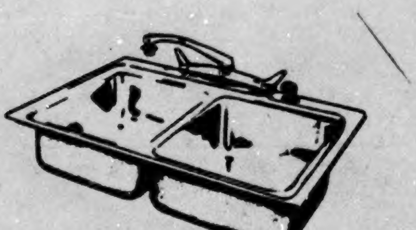
p. ______________________



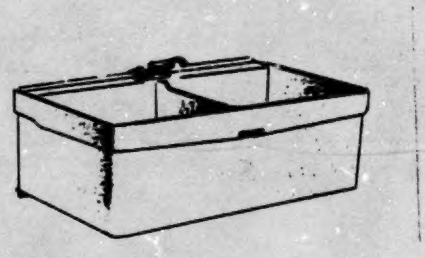
q. ______________________



r. ______________________



s. ______________________



t. ______________________

3. Match fixtures and appliances with correct installation requirements.

_____a. 1) Rated at 2 DFU

2) Requires a minimum of 1 1/2" for drain pipe

3) Requires a minimum of 1 1/4" for vent pipe

4) Requires a trap connection to the waste pipe

5) Requires a water fitting to deliver water to the nozzle

6) Has vacuum breaker on water supply

_____b. 1) Rated at 2 DFU

2) Requires a minimum of 1 1/2" for drain pipe

3) Requires a minimum of 1 1/2" for vent pipe

4) Requires a water fitting to deliver water to the sink

5) Requires a trap connection to the waste pipe

_____c. 1) Rated at 2 DFU

2) Usually installed directly below kitchen sink in place of the basket strainer

3) Requires a trap connection to the waste pipe

4) Requires kitchen sink water supply to provide adequate flushing of the drain

5) Requires electrical connection

_____d. 1) Most common fuels are gas and electricity

2) Usually constructed to heat and store water

3) Usually constructed so the controls operate automatically

1. Water closets
2. Lavatories
3. Bathtubs
4. Shower baths
5. Bidets
6. Kitchen sinks
7. Water heaters
8. Garbage disposers
9. Dishwashers
10. Laundry trays

_____e. 1) Rated at 6 DFU

2) Requires a minimum of 3" for drain pipe

3) Requires a minimum of 2" for vent pipe

4) Has trap as an integral part of the fixture

5) Has a built-in flushing device

_____f. 1) Rated at 1 DFU

2) Requires a minimum of 1 1/4" for drain pipe

3) Requires a minimum of 1 1/4" for vent pipe

4) Requires a trap connection to the waste pipe

5) Requires a water fitting to deliver water into the lavatory

_____g. 1) Rated at 2 DFU

2) Requires a minimum of 2" for drain pipe

3) Requires a minimum of 1 1/2" for vent pipe

4) Requires a trap connection to the waste pipe

5) Requires a water fitting to deliver water to the shower bath

_____h. 1) Rated at 2 DFU

2) Requires a minimum of 1 1/2" for drain pipe

3) Requires a minimum of 1 1/2" for vent pipe

4) Requires a trap and overflow connection to the waste pipe

5) Requires a water fitting to deliver water into the tub

_____i. 1) Rated at 2 DFU

2) Requires a minimum of 1 1/2" for drain pipe

3) Requires a minimum of 1 1/4" for vent pipe

4) Requires a trap connection to the waste pipe

5) Requires a water fitting to deliver water to the laundry trays

_____j. 1) Rated at 2 DFU

2) Requires a minimum of 1 1/2" for drain pipe

3) Requires a minimum of 1 1/4" for vent pipe

4) Most use a built-in pump to discharge waste water

5) Most have built-in automatic water controllers

6) Requires a trap connection to the waste pipe or disposer

4. Select true statements about the construction and materials used in the manufacture of fixtures and appliances by placing an "X" next to the left of the true statements.

_____a. Water closets are generally made in two sections--bowl and tank

_____b. Water closet tanks are not equipped with separately installed flushing mechanisms

_____c. Water closets are glazed and fired in a kiln at high heat for up to three days to ensure strength and quality of finish

_____d. Lavatories can be made from vitreous china, enameled cast iron, plastic, and fiberglass

_____e. Bath bottoms should have a 1/2" per foot pitch toward the drain

_____f. Shower baths are usually made of vitreous china

_____g. Shower baths are available in sizes of 30" x 30", 36" x 36", and 36" x 48"

_____h. Bidets are installed directly on the floor similar to a floor mounted water closet _____i. Kitchen sinks are only available in single wells

_____j. Most water heaters are steel tanks with bonded glass linings intended to prevent corrosion of the tank

_____k. Water heaters are constructed with five pipe openings in the top

_____l. Black iron pipe and fittings should be used for the gas piping in gas water heaters

_____m. Water heaters are constructed with drain valves (boiler drains) at the bottom of the water tank

_____n. The electrical work for an electric water heater should be done by the plumber

_____o. Some electric water heaters have two heating elements

_____p. The four main components of a garbage disposer are the electric motor, grinding chamber, two grinding elements, and the sink fitting

_____q. Most disposers do not have a dishwasher drain connection

_____r. Dishwashers are available in self contained units which need water and waste connections

_____s. Most laundry trays are made of fiberglass, cast iron, or wood

_____t. Double compartment and single compartment laundry trays are available

5. Demonstrate the ability to:

   a. Install a water closet (floor mount).

   b. Install a lavatory (wall hung type).

   c. Install a bathtub (5' recessed).

   d. Install shower bath accessories in a ceramic tile bathtub.

   e. Install an electric water heater.

   f. Install a dishwasher.

   g. Install a garbage disposal unit.

   h. Install a gas water heater.

(NOTE: If these activities have not been accomplished prior to the test, please ask your instructor when they should be completed.)

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FIXTURES AND APPLIANCES
UNIT IV

ANSWERS TO TEST

1. a. 6
   b. 13
   c. 16
   d. 3
   e. 9
   f. 12
   g. 19
   h. 2
   i. 14
   j. 7
   k. 21
   l. 8
   m. 17
   n. 1
   o. 11
   p. 20
   q. 15
   r. 4
   s. 18
   t. 10
   u. 5
   v. 22

2. a. Gas water heater
   b. Garbage disposer
   c. One piece fiberglass shower enclosure
   d. Floor model laundry tray
   e. Dishwasher
   f. Wall hung lavatory with raised back
   g. Self-rimming kitchen sink
   h. Floor set water closet with close coupled tank and bowl
   i. Bidet
   j. Electric water heater
   k. Recessed bathtub
   l. Shower base

m. One piece floor set tank and bowl combination water closet

n. Wall-hung siphon jet water closet with close-coupled tank and bowl

o. Self-rimming vanity lavatory

p. Under-counter vanity lavatory

q. Rim type vanity lavatory

r. Bath shower module

s. Rim-type kitchen sink

t. Wall hung laundry tray

3. a. 5
   b. 6
   c. 8
   d. 7
   e. 1
   f. 2
   g. 4
   h. 3
   i. 10
   j. 9

4. a, c, d, g, h, j, l, m, o, p, r, t .

5. Performance skills evaluated to the satisfaction of the instructor

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

UNIT OBJECTIVE

After completion of this unit, the student should be able to install a prefabricated air chamber in a water supply line, replace a section of galvanized water supply pipe, a gas water heater, and a pressure control switch on a water pump, and repair various sections of the plumbing system. This knowledge will be evidenced by correctly performing the procedures outlined in the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with maintenance and repair to the correct definitions or descriptions.
2. Describe methods of thawing frozen pipes.
3. Describe emergency repair methods for fixing leaking pipes.
4. Match water closet tank malfunctions and their causes to correct remedies for those malfunctions.
5. Demonstrate the ability to:
    a. Install a prefabricated air chamber in a water supply line.
    b. Replace a section of galvanized water supply pipe.
    c. Thaw a frozen pipe with a plumber's torch.
    d. Repair a leaking water faucet or valve.
    e. Repair a leaking shower valve.
    f. Replace a gas water heater.
    g. Repair a ball cock on a water closet.
    h. Replace a pressure control switch on a water pump.
    i. Insulate water lines.

P-1-G

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

SUGGESTED ACTIVITIES

I. Instructor:

- A. Provide student with objective sheet.
- B. Provide student with information and job sheets.
- C. Make transparencies.
- D. Discuss unit and specific objectives.
- E. Discuss information sheet.
- F. Demonstrate and discuss the procedures outlined in the job sheets.
- G. Have local contractor visit the class to discuss related information
- H. Give test.

II. Student:

- A. Read objective sheet.
- B. Study information sheet.
- C. Complete job sheets.
- D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

- A. Objective sheet
- B. Information sheet
- C. Transparency masters
    1. TM 1--Methods of Thawing Frozen Pipe
    2. TM 2--Emergency Water Pipe Repair
    3. TM 3--The Water Closet Tank
    4. TM 4--Ball Cock
    5. TM 5--Ball Valve

D. Job sheets

1. Job Sheet #1--Install a Prefabricated Air Chamber in a Water Supply Line
2. Job Sheet #2--Replace a Section of Galvanized Water Supply Pipe
3. Job Sheet #3--Thaw a Frozen Pipe With a Plumber's Torch
4. Job Sheet #4--Repair a Leaking Water Faucet or Valve
5. Job Sheet #5--Repair a Leaking Shower Valve
6. Job Sheet #6--Replace a Gas Water Heater
7. Job Sheet #7--Repair a Ball Cock on a Water Closet
8. Job Sheet #8--Replace a Pressure Control Switch on a Water Pump
9. Job Sheet #9--Insulate Water Lines

E. Test

F. Answers to test

II. Unit references:

A. Blankenbaker, E. Keith. *Modern Plumbing*. South Holland, Illinois: Goodheart-Willcox, 1978.

B. Naval Training Command. *Rate Training Manual-Utilitiesman 3 and 2*, Washington, D.C.: U.S. Government Printing Office, 1973.

4-G

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Maintenance--Keeping equipment and plumbing systems functioning in an approved manner

B. Repair--To remedy or restore that which is broken or in unworkable condition

C. Open flame--Flame not confined to a protected area and therefore dangerous

D. Malfunction--Failure to operate in a normal or usual manner

E. Frozen pipe--Water frozen in a pipe causing a stoppage and danger of pipe damage

II. Methods of thawing frozen pipes (Transparency 1)

A. Open flame

(NOTE: Do not use an open flame to thaw pipes inside a building.)

1. Open faucet or valve affected by the freeze

2. Apply heat at the lowest open end of the frozen section

   (NOTE: Do not start in the middle of a frozen section as a pocket of steam could develop and an explosion or damage to the pipe could occur.)

3. Slowly move the flame along the length of the frozen section of pipe

4. Repeat step 3 until water flows freely from pipe

B. Hot water

(NOTE: This method is recommended for use inside buildings.)

1. Open faucet or valve affected by the freeze

2. Wrap the frozen section of pipe with clean cloths

   (NOTE: Avoid oily cloths or other nonabsorbent cloths.)

3. Pour hot water over the entire length of the frozen area, starting from the open end of the pipe

4. Repeat step 3 until water flows freely from the pipe

C. Electrical (welding generator)

(NOTE: The electrical method is most commonly used to thaw service pipes and other underground lines.)

1. Determine the location of the frozen section of pipe

2. Select contact points as close as possible to the frozen area

3. Be sure that contact points are free of rust, grease, or scale

4. Remove meters, electrical ground connections, and couplings attached to plumbing in line to be thawed

   (NOTE: If there are gaskets or other insulators at pipe joints, thaw pipe in section between such joints or use copper jumpers.)

5. Set the direct-current generator to correct amperage for pipe to be thawed (Table 1)

6. Connect pipe

   (NOTE: On alternating-current circuits, a transformer must be used to adjust the amperage to the pipe being thawed.)

TABLE 1

Table 1.--Relation of current and voltage required for thawing

Type of pipe	Pipe size (in.)	Pipe length (ft.)	Approximate (volts)	Approximate (amps.)[1]
Wrought Iron	3/4	600	60	250
	1	600	60	300
	1 1/2	600	60	350
	2	500	55	400
	3	400	40	450
Cast Iron	4	400	50	500
	6	400	50	600
	8	300	40	600

[1] USE NO MORE THAN 100 AMPERES ON LEAD PIPES WHICH HAVE LEAD FITTINGS OR ANY SOLDERED JOINTS.

7. Apply current until water flows freely

6-G

INFORMATION SHEET

D. Flowing hot water

1. Remove fittings from pipe to be thawed
2. Insert small pipe or tube into open end of frozen pipe
3. Add an elbow and piece of vertical pipe to the outer end of the thaw pipe
4. Place a bucket under the opening of the frozen pipe
5. Insert a funnel in the open end of the vertical pipe
6. Pour boiling water through the funnel and into the thaw pipe
7. As the ice melts, push the thaw pipe further into the frozen pipe
8. Withdraw the thaw pipe quickly when the water starts to flow

   (NOTE: Do not stop the flow until the thaw pipe is fully removed and cleared of ice.)

E. Hair dryer

(NOTE: A pistol type hair dryer works best.)

1. Open faucet or valve affected by the freeze
2. Connect dryer to electrical power
3. Apply heat over entire length of frozen area, starting from the open end of the pipe
4. Repeat step 3 until water flows freely

III. Emergency repair methods for fixing leaking pipes (Transparency 2)

(NOTE: Emergency repairs are strictly temporary.)

A. Rubber hose method

1. Turn off the water supply
2. Cut the defective section of pipe at the leak.
3. Slip a small section of hose over the one end and line up pipes evenly

   (NOTE: Inside diameter of hose must be nearly the same as outside diameter of defective pipe.)

INFORMATION SHEET

4. Slide hose half way over the other cut end

5. Fasten hose tightly with hose clamps

B. Sheet metal clamps method

1. Turn off the water supply

2. Wrap the leaky area with sheet rubber

3. Place sheet metal clamps, one on either side of the pipe, on the sheet rubber covering

4. Fasten the clamps with bolts and nuts

(NOTE: Clamps can be purchased from plumbing supply houses or they can be made from scrap sheet metal.)

C. C-clamp method

1. Turn off the water supply

2. Cut a small piece of sheet rubber and place on the defective part of the pipe

3. Place a small wooden block on the rubber sheet

4. Place C-Clamp in position and tighten against wooden block to hold sheet rubber on pipe

(NOTE: A hose clamp can also be used in some cases.)

IV. Water closet tank malfunctions and their causes and remedies (Transparencies 3, 4, 5)

A. Water continues to flow, draining into overflow tube due to float rising too high in tank

1. Make sure float is clear of tank sides and is not held in a high position by bending float arm

2. Make sure float does not rise above desired water level by bending float arm until desired level is achieved

(NOTE: Use both hands to bend float arm as the ball cock can be damaged by excessive strain on the float arm connection.)

INFORMATION SHEET

B. Water continues to flow, draining through tank ball valve due to worn or deformed tank ball

   1. Clean existing ball and wipe valve seat clean

   2. If valve continues to leak, replace tank ball

C. Tank ball assembly fails to reseat ball valve due to misalignment

   1. Make sure lift rods are straight and aligned over ball valve

   2. Make sure trip lever is aligned over the ball valve

   3. Make sure rod guide is aligned over ball valve

D. Water continues to flow after float rises to normal shut-off position due to leaking ball cock valve

   1. Check linkage of float arm lever and valve plunger for defects which prevent valve closing

      (NOTE: Some water corrodes brass parts.)

   2. Replace valve washer

E. Water continues to flow, draining into base of overflow tube due to corrosion of threaded end of overflow tube

   1. Remove overflow tube and clean broken threads from tube base

   2. Install new overflow tube

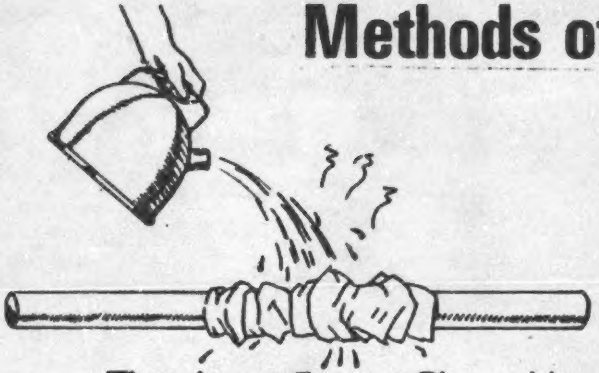
      (NOTE: Measure and cut to correct length before installing.)

F. Water continues to flow as float does not rise due to being water logged

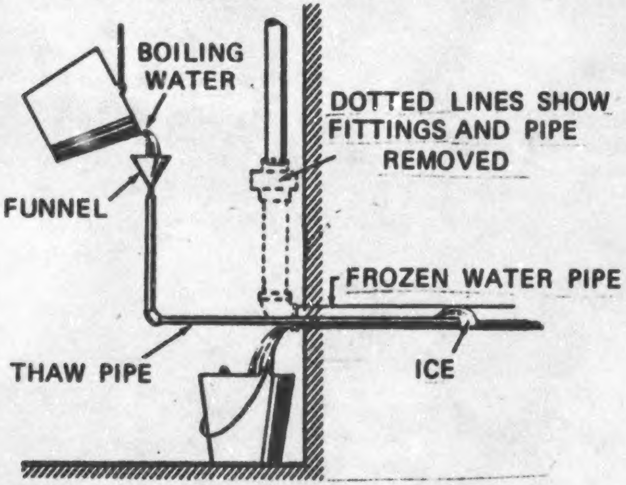
   1. Remove float and make repairs

   2. Remove float and replace with new float

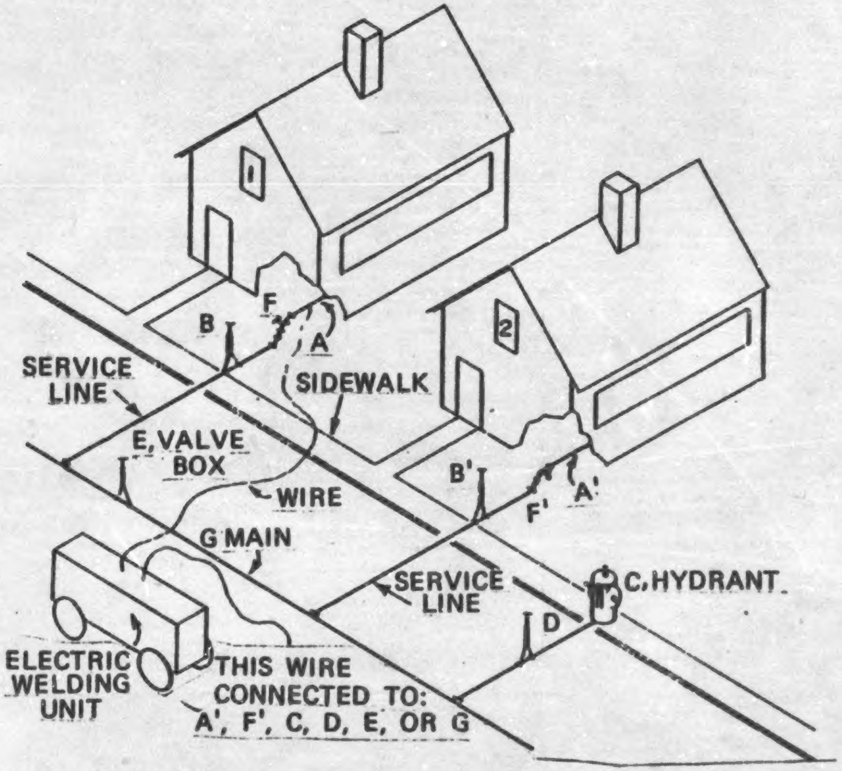
Methods of Thawing Frozen Pipe



Thawing a Frozen Pipe with Hot Water on Absorbent Cloths

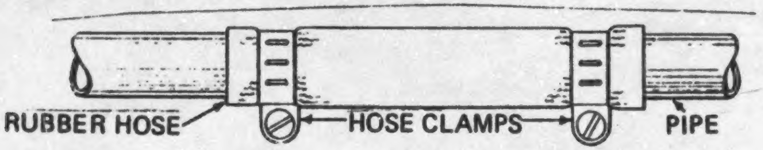

BOILING WATER
DOTTED LINES SHOW FITTINGS AND PIPE REMOVED
FUNNEL
FROZEN WATER PIPE
THAW PIPE
ICE

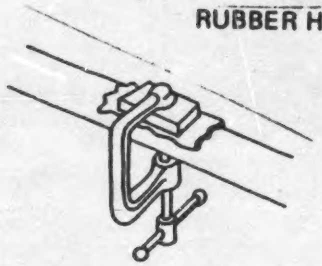
Thawing an Underground or Otherwise Inaccessible Pipe


1
2
B
F
A
SERVICE LINE
SIDEWALK
E, VALVE BOX
WIRE
B'
A'
F'
G MAIN
SERVICE LINE
C, HYDRANT
D
ELECTRIC WELDING UNIT
THIS WIRE CONNECTED TO: A', F', C, D, E, OR G

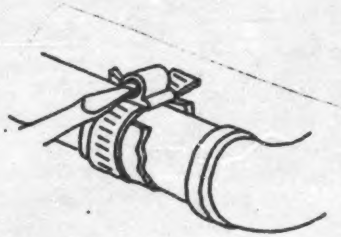
Connection Points for Thawing Frozen Service Lines

Emergency Water Pipe Repairs

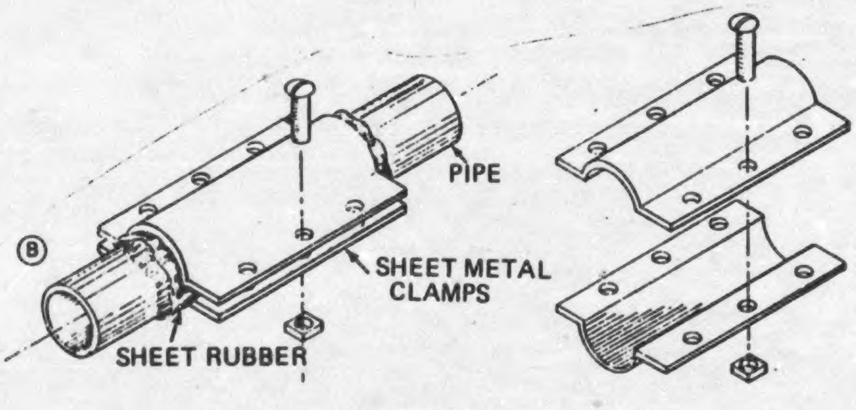

RUBBER HOSE
HOSE CLAMPS
PIPE



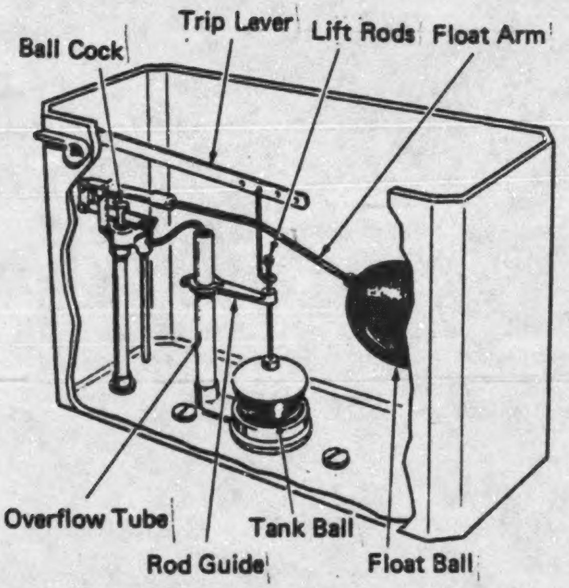
C-Clamp and a small block of wood will stop leak when nothing else is at hand. Use rubber here ,too.



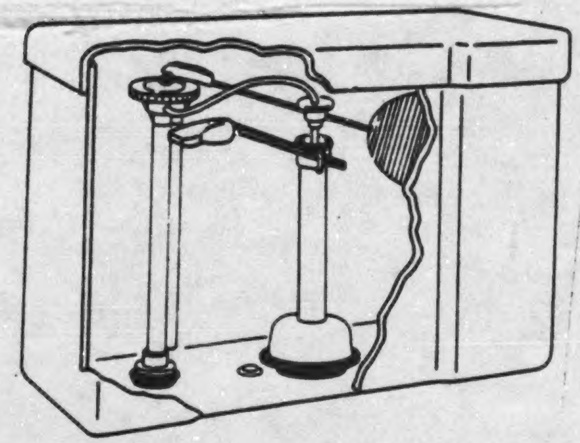
Hose Clamp (size 16 or 12) stops pinhole leak on any size pipe. Be sure to use with a rubber blanket.


Ⓑ
PIPE
SHEET METAL CLAMPS
SHEET RUBBER

Water Closet Tank


Trip Lever
Ball Cock
Lift Rods
Float Arm
Overflow Tube
Tank Ball
Rod Guide
Float Ball

Cutaway view shows principle parts of a water closet tank. Some parts are known by several different names.



Plastic Tank and Controls

Illustration provided by Mansfield Sanitary, Incorporated of Perrysville, Ohio, a subsidiary of Interpace Corporation.

Ball Cocks

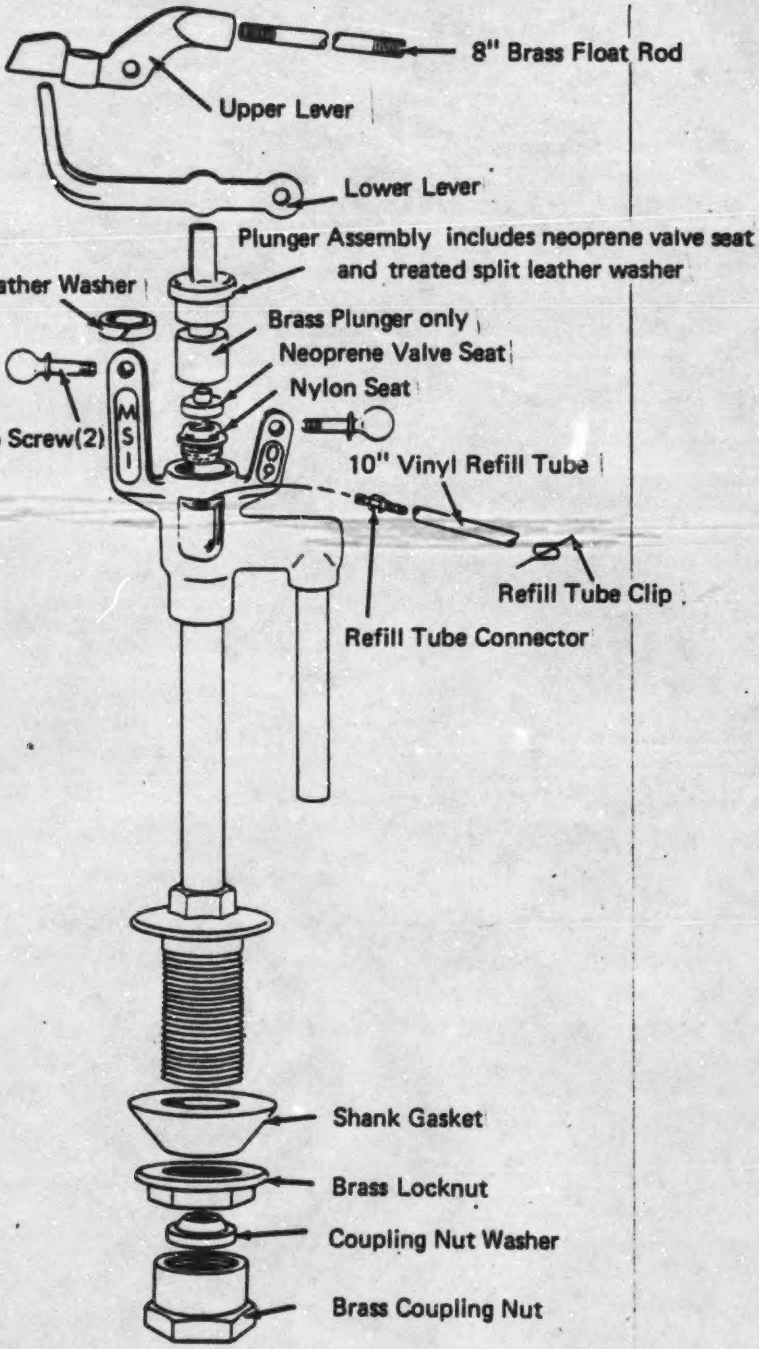

8" Brass Float Rod
Upper Lever
Lower Lever
Plunger Assembly includes neoprene valve seat and treated split leather washer
Treated Split Leather Washer
Brass Plunger only
Neoprene Valve Seat
Nylon Seat
Thumb Screw(2)
MSI
10" Vinyl Refill Tube
Refill Tube Clip
Refill Tube Connector
Shank Gasket
Brass Locknut
Coupling Nut Washer
Brass Coupling Nut

Illustration provided by Mansfield Sanitary, Incorporated of Perrysville, Ohio, a subsidiary of Interpace Corporation.

Ball Valve

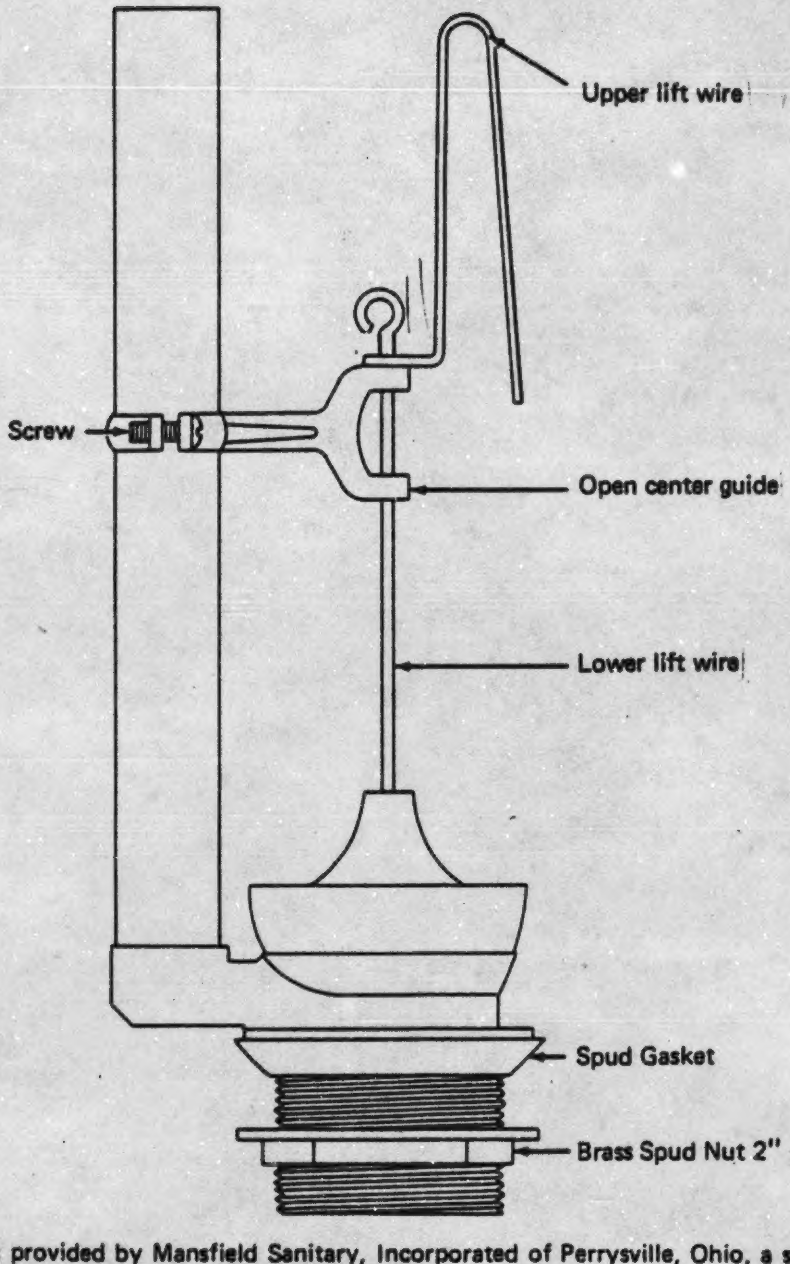

Upper lift wire
Screw
Open center guide
Lower lift wire
Spud Gasket
Brass Spud Nut 2"

Illustration provided by Mansfield Sanitary, Incorporated of Perrysville, Ohio, a subsidiary of Interpace Corporation.

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

JOB SHEET #1–INSTALL A PREFABRICATED AIR CHAMBER IN A WATER SUPPLY LINE

EVALUATION: Given access to tools, equipment, and supplies, install a prefabricated air chamber in a water supply line. When completed, the air chamber should suppress all noise caused by water hammer. Joints must not leak.

I. Tools and equipment

   A. Air chamber

   B. Tubing cutters with reamer

   C. Tee

   D. Soldering tools

      1. Torch and tank
      2. Striker
      3. Flux
      4. Sand cloth
      5. Fitting brush
      6. Solder
      7. Clean cloth

      (NOTE: To stop small amounts of water from moving through a joint to be soldered, stuff bread (household bread) into the pipe until water stops. After soldering the joint, the water can be turned on and the bread will wash out of the pipe.)

II. Procedure

   A. Determine location of noise

   B. Obtain access to water supply line

   C. Determine size of air chamber required for line

   D. Shut off water supply

   E. With tubing cutters, cut line at point where chamber will be installed

F-21-G

JOB SHEET #1

F. Drain water from the line

G. After removing burrs by reaming, clean tubing ends with sandcloth

H. Clean solder cups on air chamber and tee

I. Apply flux to all parts to be soldered

J. Place the air chamber in position in the line and support it to assure that it is level and plumb

K. Light the torch and solder the connections

(NOTE: Wipe excess solder and flux from joint using a clean cloth.)

L. When joints are cooled, turn on water and test for water hammer

M. Check with instructor for approval of job

N. Clean up the area and return all tools and equipment

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

JOB SHEET #2--REPLACE A SECTION OF GALVANIZED WATER SUPPLY LINE

EVALUATION: Given a four-wheel cutter, pipe wrenches, a pipe nipple, half unions, a pipe vise, reamer, pipe sealant, and pipe threaders, replace a section of galvanized water supply line installed horizontally underneath a raised floor. The completed pipe joints must not leak.

I. Tools and equipment

  A. Four wheel pipe cutter

  B. Pipe wrenches

  C. Steel pipe nipple

  D. Steel union

  E. Pipe vise

  F. Pipe threader

  G. Pipe reamer

  H. One wheel pipe cutter

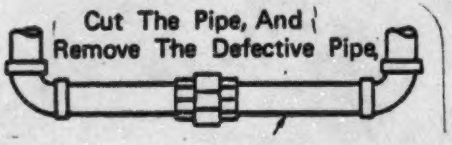
  I. Pipe compound or tape

  J. Flat file

  (NOTE: If outside burr from four wheel cutter operation is excessive, a flat file must be used to remove the burr.)

II. Procedure (Figure 1)

Figure 1



Install A New Section Of Pipe And A Union.

  A. Turn off water supply

  B. Measure length of pipe to determine length of replacement

  C. Cut pipe at desired location, using a four-wheel cutter

C. Disconnect pipe and fitting, disconnecting hangers if necessary

D. Assemble nipple and half union, and connect to fittings in supply line

E. Measure, cut, and thread replacement pipe, allowing for fittings

F. Connect unions

G. Turn on water supply

H. Check for leaks

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

JOB SHEET #3--THAW A FROZEN PIPE WITH A PLUMBER'S TORCH

EVALUATION: Given an exposed, frozen, steel water supply pipe, a torch, and necessary materials, thaw the pipe. Water must flow freely through the pipe after thawing.

A. Torch and tank

B. Pipe (for simulated frozen condition)

C. Fire extinguisher

(NOTE: A fire extinguisher should be kept in a convenient location any time a torch is used.)

D. Asbestos sheeting or other fireproof material

II. Procedure

A. Locate frozen area of pipe

B. Open faucet or valve

C. Light torch and adjust flame

D. Apply heat in a back and forth motion over entire length of freeze

(CAUTION: Take precautions against fire by using asbestos sheeting or other fireproof material.)

E. Continue step D until water runs freely through lines

F. Remove torch and extinguish flame

G. Allow water to flow for several minutes to avoid refreezing

H. Close faucet or valve

MAINTENANCE AND REPAIR
WATER SYSTEMS
UNIT I

JOB SHEET #4--REPAIR A LEAKING WATER FAUCET OR VALVE

EVALUATION: Given a strap wrench, screwdriver, knife, washers, and a seat-dressing tool, repair a leaking water faucet. The faucet must not be marred by plumbing tools, and it must not leak after repair.

I. Tools and equipment

- A. Strap wrench
- B. Screwdriver
- C. Compression type faucet
- D. Adjustable wrench
- E. Knife
- F. Washers
- G. Seat-dressing tool
- H. Packing ring
- I. Handle puller
- J. Stem grease

II. Procedure

(NOTE: Refer to figure 1.)

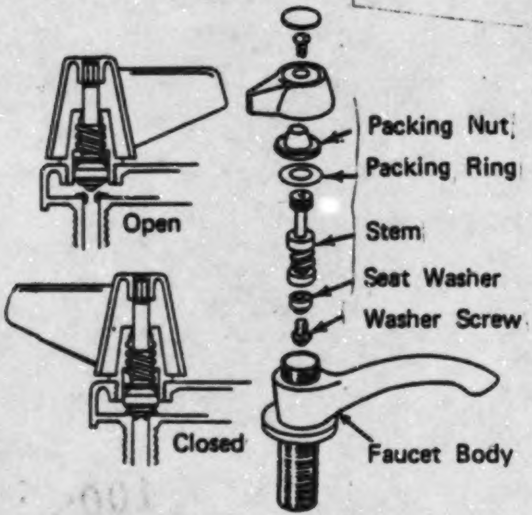

Open
Closed
Packing Nut
Packing Ring
Stem
Seat Washer
Washer Screw
Faucet Body

Figure 1

F-27-G

JOB SHEET #4

A. Shut off water supply to faucet

B. Turn faucet handle to open faucet and remove handle

C. Remove packing nut using adjustable wrench

D. Remove spindle to expose washer

E. Check seat for wear

F. Inspect stem for wear

G. Remove brass washer screw with screwdriver

H. Lift washer with knife tip

I. Replace washer with new one and tighten with screwdriver

J. Replace packing ring between cap nut and spindle as follows:

   1. Remove cap nut and spindle
   2. Remove handle from top of stem using a handle puller wrench
   3. Replace packing ring

K. Dress faucet ground seat as follows:

   1. Insert seat-dressing tool in faucet, and press threaded cone down into body opening
   2. Center spindle and cutter in faucet
   3. Using moderate downward pressure, rotate handwheel to the right to dress seat

      (NOTE: Seat should be clean and free from burrs and knicks when dressed.)

L. Reassemble remaining parts

   (NOTE: Apply stem grease to stem.)

M. Check with instructor for approval of job

N. Clean up the area and return all tools and equipment

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

JOB SHEET #5--REPAIR A LEAKING SHOWER VALVE

EVALUATION: Given an adjustable wrench and a valve-seat wrench, repair a leaking shower valve. When completed, the shower valve must not leak.

I. Tools and equipment

   A. Adjustable wrench

   B. Screwdrivers

   C. Plumber's socket wrench set

   D. Valve seat wrench

   E. Valve seat (new)

   F. Washer (new)

   G. Pipe compound

   H. Clean cloth

   I. Knife

   J. Handle puller

   K. Stem grease

II. Procedure

   A. Cut off water supply to valve

   B. Remove valve handle with handle puller

   C. Remove escutcheon

   D. Loosen valve bonnet with socket wrench and remove valve stem assembly

   E. Remove and replace valve seat, using valve-seat wrench

   F. Remove washer on end of stem using knife tip

   G. Replace washer using screwdriver

   H. Reassemble valve using pipe compound to lubricate threads

   I. Tighten packing nut using adjustable wrench
   (NOTE: Apply stem grease to stem.)

   J. Replace escutcheon and valve handle

JOB SHEET #5

K. Wipe valve and adjacent area with clean cloth

L. Check with instructor for approval of job

M. Return all tools and clean up the area

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

JOB SHEET #6–REPLACE A GAS WATER HEATER

EVALUATION: Given access to plumbing tools, equipment and materials, replace a gas water heater. Finished work must be approved by the instructor using the accompanying check-list. All items must be rated "yes" for satisfactory performance.

I. Tools and equipment
    A. Tubing cutter
    B. Garden hose
    C. Soldering tools
        1. Torch and tank
        2. Solder
        3. Flux with brush
        4. Striker
        5. Sand cloth and fitting brush
        6. Clean cloth
    D. Temperature and pressure relief valve
    E. Fittings
    F. Pipe wrenches
    G. Tin snips
    H. Pipe compound or tape
    I. Screw driver
    J. Cloths to wipe up spilled water

II. Procedure
    A. Close gas valve to heater
    B. Close water supply valve to water heater
    C. Connect garden hose from heater drain valve to nearest drain or place outdoors

    (NOTE: Do not run water on lawn or flower beds.)

D. Open heater drain valve and drain as much water from the heater as possible

(NOTE: The highest hot water faucet in house must be open in order to allow water to leave the heater and drain the water line.)

E. Set up tools and equipment and bring in the new water heater while water drains from old heater

F. Disconnect the relief valve over-flow line

G. Disconnect gas supply at union near heater

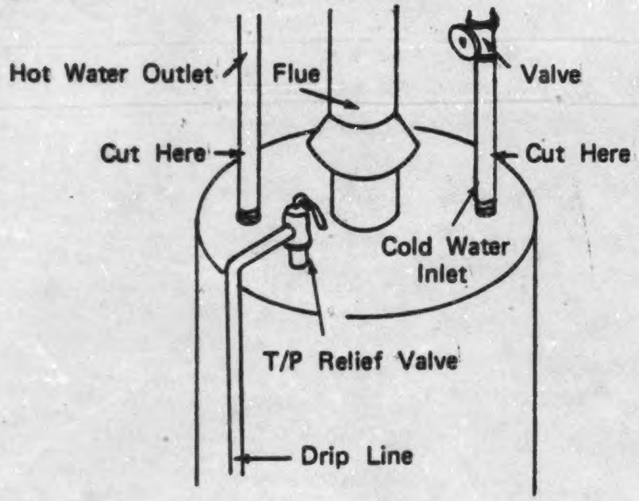
H. Remove gas connection on heater

I. Remove flue pipe

J. Close drain valve and remove garden hose when tank is empty

K. Cut hot and cold lines directly above heater with tubing cutters (Figure 1)

Figure 1



L. Remove old water heater from its present position and replace with new heater

(NOTE: New heater should have been ordered to correspond to the same height as the old heater.)

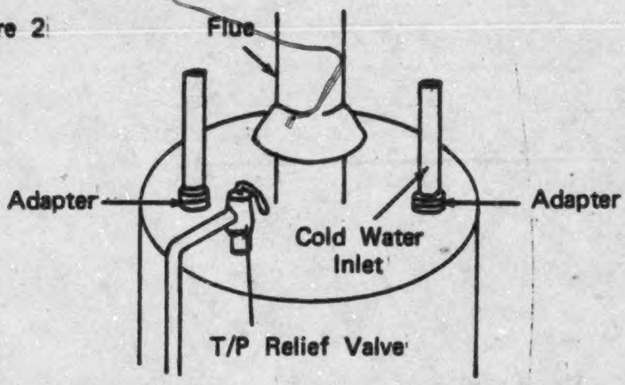
M. Line up gas and water supplies with the new heater connections

JOB SHEET #6

N. Remove adapters from old heater and reuse if not damaged (Figure 2)

(NOTE: Install new relief valve.)

Figure 2



O. Connect water supplies to heater using couplings or new pipe

P. Connect gas supply to heater

Q. Connect flue pipe from heater to chimney

(NOTE: Reseal at chimney to prevent flue gas leaks and in proper combustion according to local codes.)

R. Make sure drain valve is closed and turn on water supply

(NOTE: Close highest hot water faucet when water flows freely.)

S. Check for water leaks

T. Open gas valve to heater

U. Check for gas leaks using soap and water

V. Light gas pilot and burner

W. Adjust flame if necessary

X. Check with instructor for approval of job

Y. Clean up area and replace tools

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write YES in the space provided. If the performance is unsatisfactory, write NO in the space. Each item must be rated "yes" for satisfactory task performance.

1. Vent pipe is positioned properly. ______________
2. Roof flashing prevents water leaks. ______________
3. Hot water heater burner flame is properly adjusted. ______________
4. Hot and cold water supply lines do not leak. ______________
5. Hot water heater is installed in a stable position. ______________
6. Relief valve outlet is properly installed. ______________
7. Heater is positioned for accessible maintenance. ______________

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WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

JOB SHEET #7--REPAIR A BALL COCK ON A WATER CLOSET

EVALUATION: Provided with a screwdriver, adjustable wrench, vise-grip pliers, and repair supplies, repair a diaphragm-type ball cock on a water closet. The ball cock must provide rapid, automatic delivery of water and must not overflow the fixture.

I. Tools and equipment

   A. Water closet (tank type)

   B. Screwdrivers

   C. Adjustable wrench

   D. Spud wrench or all-purpose wrench

   E. Vise-grip pliers

   F. New ball cock

   G. Pipe compound

   H. Clean cloth

   I. Sponge

II. Procedure

   A. Shut off water at fixture stop valve

   B. Remove top from tank

   C. Completely drain the tank and sponge out the water that does not drain

   D. Remove the nut from underside of closet tank which holds ball cock and lift flush valve from tank

   E. Remove diaphragm and rubber seat from guide

   F. If worn, replace diaphragm, plunger, and seat washer

   G. If worn, replace diaphragm guide

   H. Replace ball cock if above steps are inappropriate

   I. Replace tank top

   J. Turn water on

   K. Check operation of ball cock

L. Check with instructor for evaluation of job

M. Replace all tools and equipment

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

JOB SHEET #8--REPLACE A PRESSURE CONTROL SWITCH ON A WATER PUMP

EVALUATION: Given a screwdriver and a set of open-end wrenches, replace a malfunctioning pressure control switch on a pump. The new switch must function to provide an amount of water at the pressure level designated by the pump manufacturer.

I. Tools and equipment

   A. Water pump with pressure control

   B. New pressure control

   C. Screwdriver

   D. Set of open-end wrenches

   E. Pipe compound or tape

II. Procedure

   A. Turn off power supply

   B. Remove cover from pressure switch

   C. Disconnect wiring on switch, observing carefully the correct location of wire leads on the switch

   D. Remove switch from pump using open-end wrench

   E. Install new switch on pump using open-end wrench

   (NOTE: Apply pipe compound or tape to male threads.)

   F. Connect wire leads on switch using a screwdriver

   G. Turn on power supply

   H. Check operation of pump

   (NOTE: Switch may have to be adjusted to produce the desired pressure and differential.)

   I. Check with instructor for evaluation of job

   J. Return all tools and clean up the area

1-31-8

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

JOB SHEET #9--INSULATE WATER LINES

EVALUATION: Given 1 1/4" frost proof pipe insulation and a 1" diameter plastic water line exposed to freezing temperatures, insulate the line. All exposed surfaces of the pipe must be covered with insulation.

I. Tools and equipment

- A. Insulation
- B. Pipe and fittings
- C. Insulation cement
- D. Pocket knife
- E. Duct tape

II. Procedure

- A. Spread split insulation
- B. Fit over straight length of pipe
- C. Butt each 3' length end to end
- D. Apply cement to canvas overlap tab
- E. Press both edges of insulation together
- F. Press canvas to tab down
- G. Cut V-notch in center of elblow to fit around elbow
- H. Fold insulation over elbow
- I. Mold together
- J. Notch out at center of tee outlet to fit around tee
- K. Split insulation
- L. Fit around tee
- M. Cut V-shaped piece of insulation to size needed
- N. Slide into notch at center of tee

1-3-1-5

O. Apply duct tape if needed

P. Check with instructor for evaluation

Q. Clean up the area and return all tools and equipment

WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions or descriptions.

_____a. Keeping equipment and plumbing systems functioning in an approved manner

_____b. To remedy or restore that which is broken or in unworkable condition

_____c. Flame not confined to a protected area and therefore dangerous

_____d. Water frozen in a pipe causing a stoppage and danger of pipe damage

_____e. Failure to operate in a normal or usual manner

1. Frozen pipe
2. Repair
3. Malfunction
4. Maintenance
5. Open flame

2. Describe three methods of thawing frozen pipes.

a.

b.

c.

3. Describe two emergency repair methods for fixing leaking pipes.

a.

b.

4. Match water closet tank malfunctions and causes on the right to their remedies.

______a. 1) Make sure float is clear of tank sides and is not held in a high position by bending float arm

2) Make sure float does not rise above desired water level by bending float arm until desired level is achieved

______b. 1) Clean existing ball and wipe valve seat clean

2) If valve continues to leak, replace tank ball

______c. 1) Make sure lift rods are straight and aligned over ball valve

2) Make sure trip lever is aligned over the ball valve

3) Make sure rod guide is aligned over ball valve

______d. 1) Check linkage of float arm lever and valve plunger for defects which prevent valve closing

2) Replace valve washer

______e. 1) Remove overflow tube and clean broken threads from tube base

2) Install new overflow tube

1. Tank ball assembly fails to reseat ball valve due to misalignment

2. Water continues to flow, draining through tank ball valve due to worn or deformed tank ball

3. Water continues to flow, draining into base of overflow tube due to corrosion of threaded end of overflow tube

4. Water continues to flow, draining into overflow tube due to float rising too high in tank

5. Water continues to flow after float rises to normal shut-off position due to leaking ball cock valve

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RP

5. Demonstrate the ability to:

   a. Install a prefabricated air chamber in a water supply line.

   b. Replace a section of galvanized water supply pipe.

   c. Thaw a frozen pipe with a plumber's torch.

   d. Repair a leaking water faucet or valve.

   e. Repair a leaking shower valve.

   f. Replace a gas water heater.

   g. Repair a ball cock on a water closet.

   h. Replace a pressure control switch on a water pump.

   i. Insulate water lines.

   (NOTE: If these activities have not been performed prior to the test, ask your instructor when they should be completed.)

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WATER SYSTEMS
MAINTENANCE AND REPAIR
UNIT I

ANSWERS TO TEST

1. a. 4

   b. 2

   c. 5

   d. 1

   e. 3

2. Description should include any three of the following methods:

   a. Open flame

      1) Open faucet or valve affected by the freeze

      2) Apply heat at the lowest open end of the frozen section

      3) Slowly move the flame along the length of the frozen section of pipe

      4) Repeat step 3 until water flows freely from pipe

   b. Hot water

      1) Open faucet or valve affected by the freeze

      2) Wrap the frozen section of pipe with clean cloths

      3) Pour hot water over the entire length of the frozen area, starting from the open end of the pipe

      4) Repeat step 3 until water flows freely from the pipe

   c. Electrical (welding generator)

      1) Determine the location of the frozen section of pipe

      2) Select contact points as close as possible to the frozen area

      3) Be sure that contact points are free of rust, grease, or scale

      4) Remove meters, electrical ground connections, and couplings attached to plumbing in line to be thawed

    5) Set the direct-current generator to correct amperage for pipe to be thawed

    6) Connect pipe

    7) Apply current until water flows freely

  d. Flowing hot water

    1) Remove fittings from pipe to be thawed

    2) Insert small pipe or tube into open end of frozen pipe

    3) Add an elbow and piece of vertical pipe to the outer end of the thaw pipe

    4) Place a bucket under the opening of the frozen pipe

    5) Insert a funnel in the open end of the vertical pipe

    6) Pour boiling water through the funnel and into the thaw pipe

    7) As the ice melts, push the thaw pipe further into the frozen pipe

    8) Withdraw the thaw pipe quickly when the water starts to flow

  e. Hair dryer

    1) Open faucet or valve affected by the freeze

    2) Connect dryer to electrical power

    3) Apply heat over entire length of frozen area, starting from the open end of the pipe

    4) Repeat step 3 until water flows freely

3. Description should include any two of the following applications:

  a. Rubber hose

    1) Turn off the water supply

    2) Cut the defective section of pipe at the leak

    3) Slip a small section of hose over the one end and line up pipes evenly

    4) Slide hose half way over the other cut end

    5) Fasten hose tightly with hose clamps

  b. Sheet metal clamps

    1) Turn off the water supply

    2) Wrap the leaky area with sheet rubber

    3) Place sheet metal clamps, one on either side of the pipe, on the sheet rubber covering

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    4) Fasten the clamps with bolts and nuts

  c. C-clamp

    1) Turn off the water supply
    2) Cut a small piece of sheet rubber and place on the defective part of the pipe
    3) Place a small wooden block on the rubber sheet
    4) Place C-clamp in position and tighten against wooden block to hold sheet rubber on pipe

4. a. 4
   b. 2
   c. 1
   d. 5
   e. 3

5. Performance skills evaluated to the satisfaction of the instructor

DRAINAGE SYSTEMS
MAINTENANCE AND REPAIR
UNIT II

UNIT OBJECTIVE

After completion of this unit, the student should be able to match terms associated with maintenance and repair of drainage systems to correct definitions or descriptions, identify equipment used to clear stoppages in plumbing fixtures, identify clean-out access points in a drainage system, and demonstrate the ability to remove obstructions from drain lines. This knowledge will be evidenced by correctly performing the procedures outlines on the job sheets and by scoring 85 percent on the unit test.

SPECIFIC OBJECTIVES

After completion of this unit, the student should be able to:

1. Match terms associated with maintenance and repair of drainage systems to the correct definitions and descriptions.
2. Identify equipment used to clear stoppages in plumbing fixtures.
3. Identify clean-out access points in a drainage system.
4. Demonstrate the ability to:
    a. Replace a lavatory trap.
    b. Clear obstructions from a lavatory drain.
    c. Clear obstructions from a water closet drain.
    d. Clear obstructions from a main drain line.

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DRAINAGE SYSTEMS
MAINTENANCE AND REPAIR
UNIT II

SUGGESTED ACTIVITIES

I. Instructor:

   A. Provide student with objective sheet.

   B. Provide student with information and job sheets.

   C. Make transparencies.

   D. Discuss unit and specific objectives.

   E. Discuss information sheet.

   F. Demonstrate and discuss the procedures outlined in the job sheets.

   G. Invite a plumbing contractor to visit the class.

   H. Give test.

II. Student:

   A. Read objective sheet.

   B. Study information sheet.

   C. Complete job sheets.

   D. Take test.

INSTRUCTIONAL MATERIALS

I. Included in this unit:

   A. Objective sheet

   B. Information sheet

   C. Transparency masters

      1. TM 1--Equipment to Clear Stoppages

      2. TM 2--Clean-out Access Points

      3. TM 3--Clean-out Access Points (Continued)

   D. Job sheets

      1. Job Sheet #1--Replace a Lavatory Trap

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2. Job Sheet #2--Clear Obstructions From a Lavatory Drain
3. Job Sheet #3--Clear Obstructions From a Water Closet Drain
4. Job Sheet #4--Clear Obstructions From a Main Drain Line

II. Unit references:

A. Blankenbaker, E. Keith. *Modern Plumbing*. South Holland, Ill.: Goodheart-Willcox, 1978.

B. *Rate Training Manual: Utilitiesman 3 and 2.* Washington, D.C.: United States Government Printing Office/Naval Training Command, 1973.

DRAINAGE SYSTEMS
MAINTENANCE AND REPAIR
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Caustic chemicals–Chemicals, either in liquid or powder form, used to dissolve soap, grease, and other accumulations in drain pipe

   B. Auger–Rotary tool used by plumbers to clean drains

   C. Plumber's friend–Plunger used to help clear fixture drains, saving the plumber from messy work

   D. Snake–Steel band or spring coiled up for easy use, used to clear plumbing drains

II. Equipment used to clear stoppages in plumbing fixtures (Transparency 1)

   (NOTE: Check for acid or any other corrosive substance before working on drains.)

   A. Plunger

      (NOTE: A plunger is also known as the plumber's friend, and as a force cup.)

   B. Closet auger

      (NOTE: After using, wash with clean water and oil to avoid rusting.)

   C. Trap and drain auger

      (NOTE: The trap and drain auger is best used on waste pipes and traps that are not easily disassembled.)

   D. Water ram

      (NOTE: Use the water ram with care as this tool can blow water out of other fixture traps.)

   E. Plumber's snake

      (NOTE: Plumber's snakes are either electric or manual. Small snakes may help to loosen stoppages in lavatory and kitchen sink traps, but the best solution is to remove and clean the trap.)

   F. Caustic chemicals

      (CAUTION: Use caustic chemicals only as a last resort, especially to remove grease and soap buildup in drain lines. Do not use in plastic pipes.)

INFORMATION SHEET

III. Clean-out access points on a drainage system (Transparencies 2 and 3)

(NOTE: Check local codes.)

A. Base of stack

(NOTE: Many codes require a clean-out at the base of each vertical drain pipe.)

B. Traps

(NOTE: Lavatory, kitchen sink, and exposed bath and shower traps should be made to be easily removed.)

C. Vent terminals

(NOTE: These are specifically intended for clearing blocked stacks.)

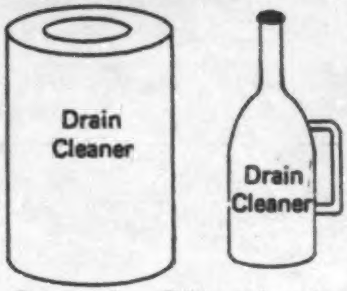
D. Clean-outs in sewer line

(NOTE: Check the local codes. Many codes require buried sewer lines to have a clean-out for every 50' of pipe.)

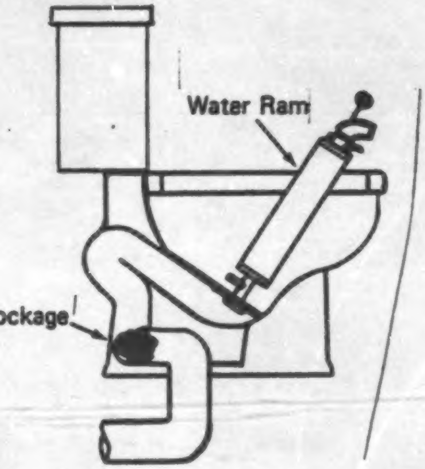
E. Water closets

(NOTE: Remove water closet for drain cleaning only after all other attempts have been made.)

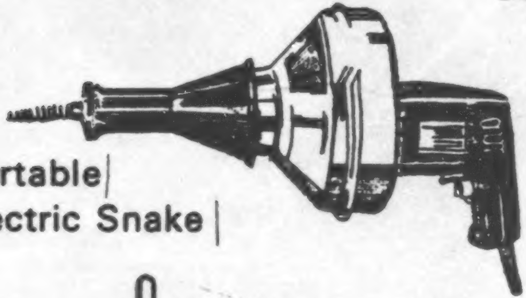
Equipment to Clear Stoppages


Drain Cleaner
Drain Cleaner

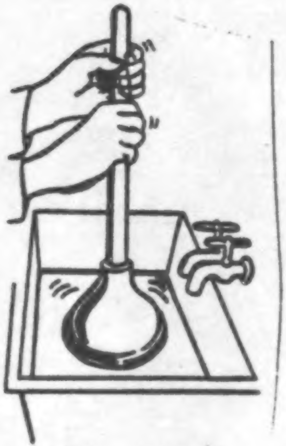
Caustic Chemicals


Water Ram
Blockage

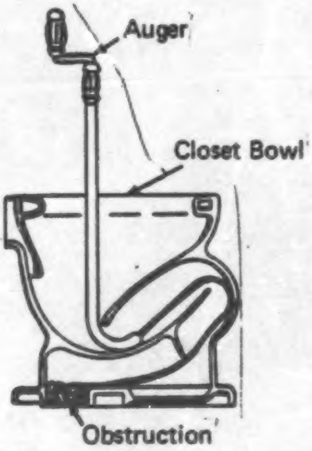
Water Ram



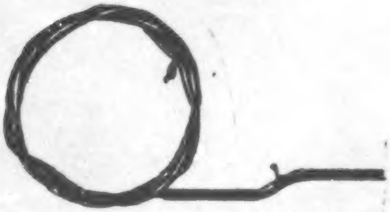
Portable Electric Snake



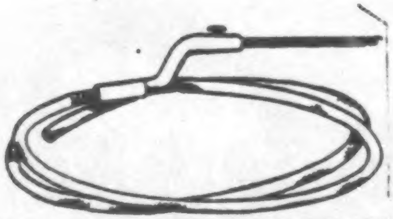
Plunger


Auger
Closet Bowl
Obstruction

Closet Auger in use



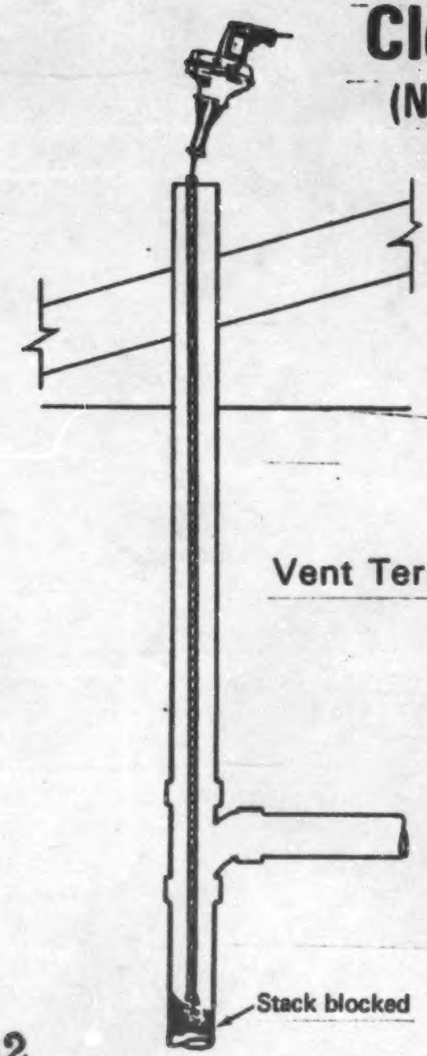
Plumber's Snake



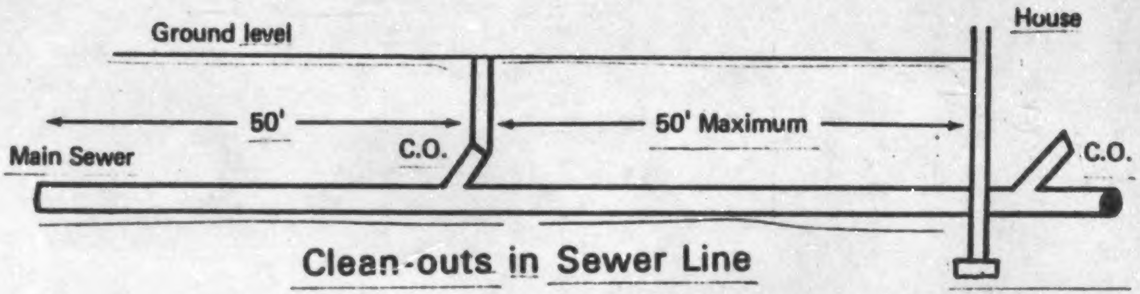
Trap and Drain Auger

Clean-out Access Points

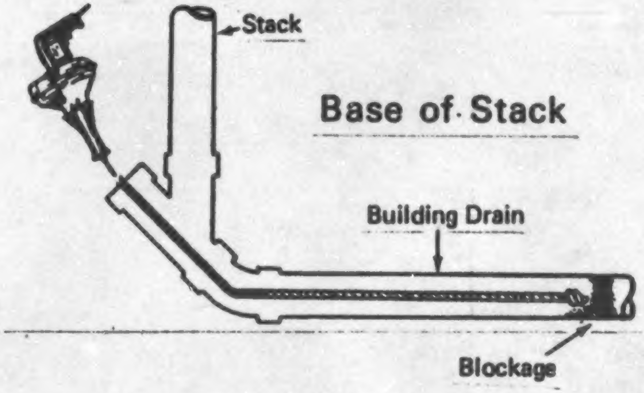
(Note: Be sure to check local codes.)


Stack blocked

Vent Terminal


Ground level
House
50'
50' Maximum
Main Sewer
C.O.
C.O.

Clean-outs in Sewer Line

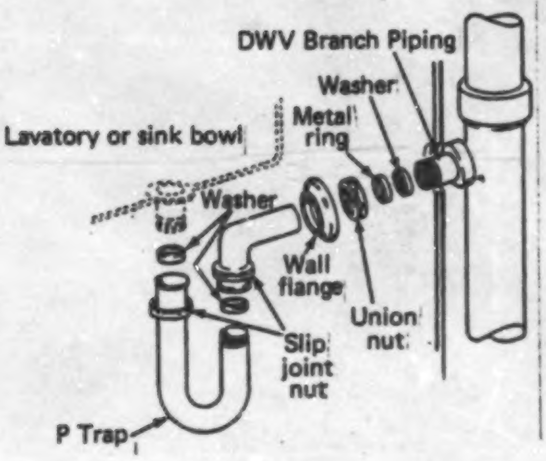

Stack
Building Drain
Blockage

Base of Stack

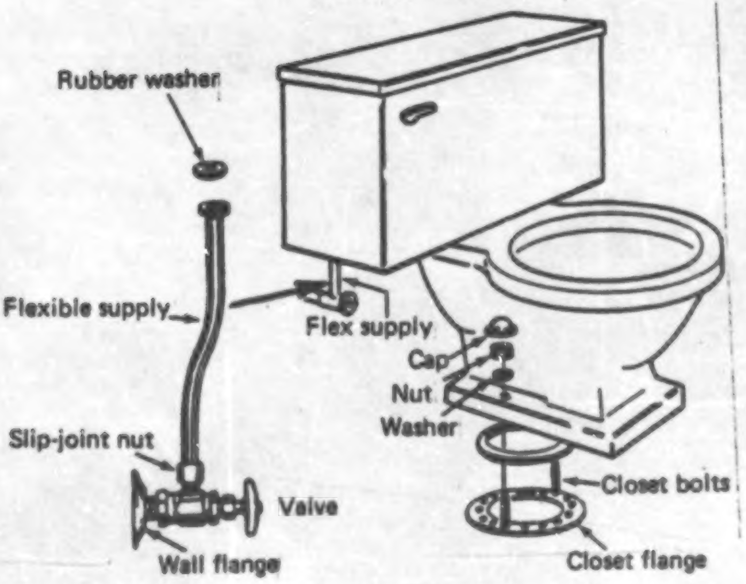
Clean-out Access Points

(Continued)

P-trap


DWV Branch Piping
Washer
Metal ring
Lavatory or sink bowl
Washer
Wall flange
Union nut
Slip joint nut
P Trap

Water Closet


Rubber washer
Flexible supply
Flex supply
Cap
Nut
Washer
Slip-joint nut
Valve
Wall flange
Closet bolts
Closet flange

Remove water closet to clean drain

DRAINAGE SYSTEMS
MAINTENANCE AND REPAIR
UNIT II

JOB SHEET #1–REPLACE A LAVATORY TRAP

EVALUATION: Given an adjustable wrench and other needed tools and equipment, replace a faulty lavatory trap. Time limit is 15 minutes. When completed, the lavatory trap must not leak.

I. Tools and equipment

  A. Lavatory with P trap

  B. Adjustable wrench or all-purpose wrench

  C. Pan to catch trap water

  D. New trap with washers and slip nuts

  E. Pipe compound

  F. Drop cloth

II. Procedure

  A. Spread drop cloth under lavatory

  B. Disconnect slip-joint nuts at lavatory trap

  (NOTE: Use pan to catch trap water.)

  C. Replace lavatory trap, using complete kit provided by manufacturer and other necessary materials

  D. Check for leaks

  E. Check with instructor of evaluation of job

  F. Clean up area and return all tools and equipment

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DRAINAGE SYSTEMS
MAINTENANCE AND REPAIR
UNIT II

JOB SHEET #2–CLEAR OBSTRUCTIONS FROM A LAVATORY DRAIN

EVALUATION: When asked by the instructor, remove obstructions from a lavatory drain. Water must flow freely through the drain.

I. Tools and equipment

- A. Lavatory with P trap
- B. Adjustable wrench
- C. All-purpose wrench
- D. Cloth
- E. Plunger
- F. Flexible cable with auger
- G. Caustic chemical
- H. Clean rag
- I. Pipe compound

II. Procedure

- A. Remove clean-out or drain stopper and check for obstruction
- B. Remove any obstruction and check for proper drainage
- C. If problem is not solved, plug overflow opening with rag, and force air and water through drain line with a vacuum plunger
- D. If problem is not solved, rod out drain line with flexible cable and auger
- E. If limited amount of water is moving, pour caustic chemical into drain, using chemical manufacturer's instructions for proper application
- F. If problem still exists, disassemble, clean, and reassemble drain and P-trap
- G. Check with instructor for evaluation of job
- H. Return and clean all tools and equipment
- I. Clean up the work site

DRAINAGE SYSTEMS
MAINTENANCE AND REPAIR
UNIT II

JOB SHEET #3–CLEAR OBSTRUCTIONS FROM A WATER CLOSET DRAIN

EVALUATION: Given a vacuum plunger and a flexible closet auger, remove obstructions from a water closet drain. The water closet must flush without overfilling.

I. Tools and equipment

   A. Water closet connected to drain system

   B. Plunger

   C. Closet auger

   D. Bucket

II. Procedure

   A. Remove cover from tank

   B. Force water through the water closet drain, using a vacuum plunger

   C. Flush water closet

   (NOTE: Be prepared to stop water flow if necessary.)

   D. If problem still exists, rod out drain with flexible cable and auger

   E. Remove auger from drain, pulling obstruction with auger

   F. If obstruction cannot be disloged with auger, disconnect water closet and remove obstruction from drain

   G. Flush with handful of toilet tissue to test flushing action

   H. Check with instructor for evaluation of job

   I. Clean and return all tools and equipment

   J. Clean up work site

DRAINAGE SYSTEMS
MAINTENANCE AND REPAIR
UNIT II

JOB SHEET #4–CLEAR OBSTRUCTION FROM A MAIN DRAIN LINE

EVALUATION: Given a power-operated sewer auger and a caustic chemical, remove obstructions from a main drain line. The drain line must accommodate the normal amount of waste.

I. Tools and equipment

   A. Power sewer auger with attachments

   B. Caustic chemical

   C. Spud wrench or clean-out wrench

   D. Heavy gloves (approved type)

   E. Clean cloths

II. Procedure

   A. Identify clean-out opening in drain line; if none exists, remove appropriate fixture

   B. Attach proper size bit on end of cable

   C. Insert bit and cable into fixture drain line

   D. Bend cable as required to reach obstruction

   E. Activate power auger and clean line, removing and cleaning auger as necessary

   F. Run water through line

   G. Repeat process until line is cleaned

   H. Replace fixture

   I. Check with instructor for evaluation of job

   J. Clean and return all tools and equipment

   K. Clean up the work site

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DRAINAGE SYSTEMS
MAINTENANCE AND REPAIR
UNIT II

NAME ______________________________

TEST

1. Match the terms on the right to the correct definitions and descriptions.

_____a. Chemicals, either in liquid or powder form, used to dissolve soap, grease, and other accumulations in drain pipe

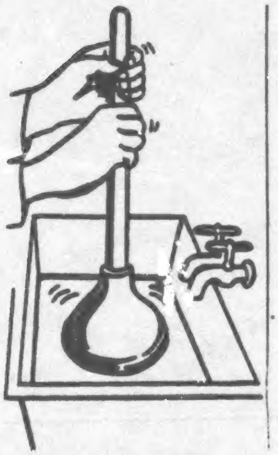
_____b. Rotary tool used by plumbers to clean drains

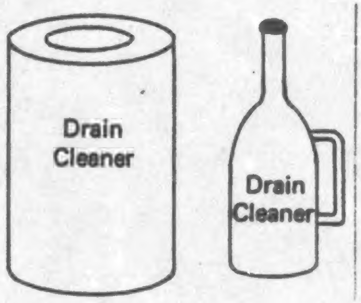
_____c. Plunger used to help clear fixture drains, saving the plumber from messy work

_____d. Steel band or spring coiled up for easy use, used to clear plumbing drains

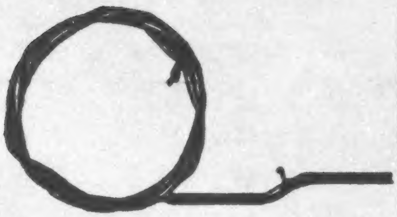
1. Plumber's friend
2. Snake
3. Auger
4. Caustic chemicals

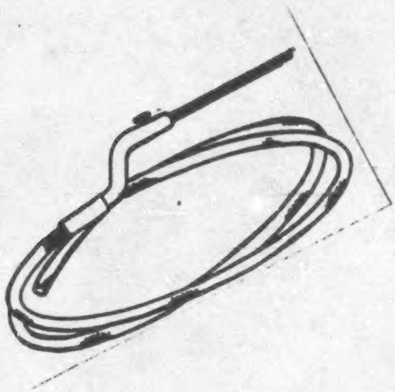
2. Identify equipment used to clear stoppages in plumbing fixtures.



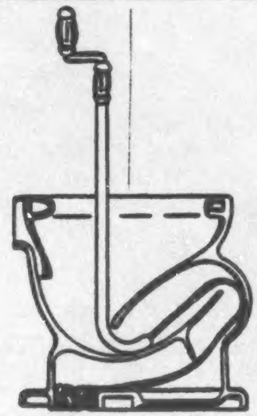


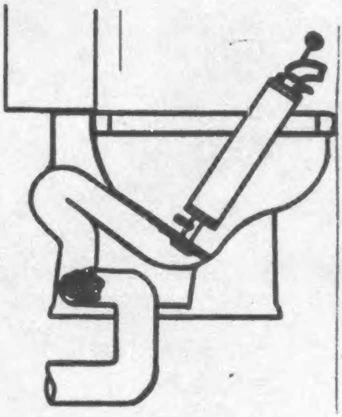
a. ______________________________ b. ______________________________





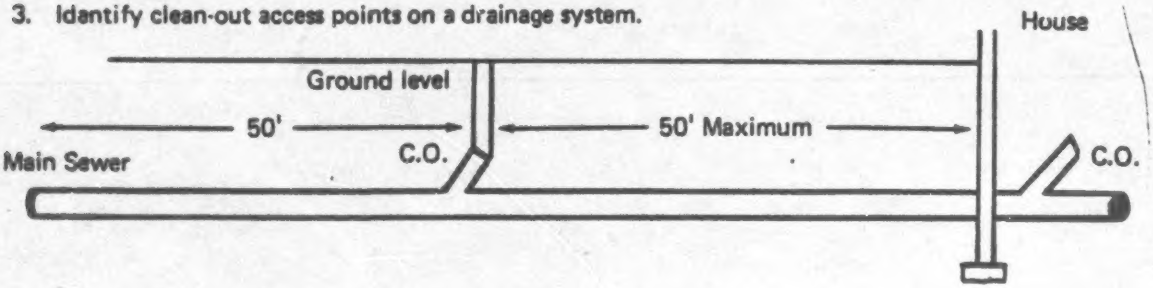
c. ______________________ d. ______________________



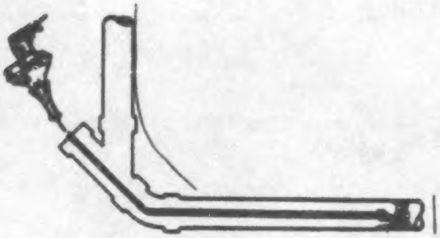


e. ______________________ f. ______________________

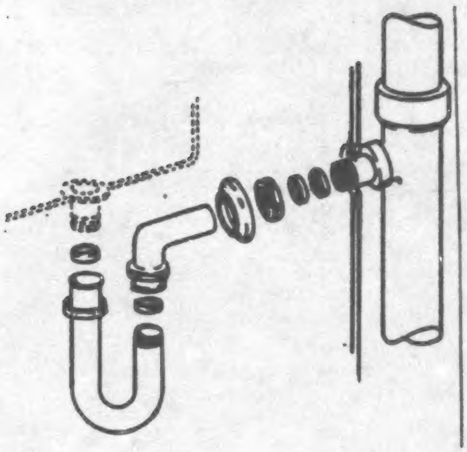
3. Identify clean-out access points on a drainage system.


House
Ground level
50'
50' Maximum
C.O.
Main Sewer
C.O.

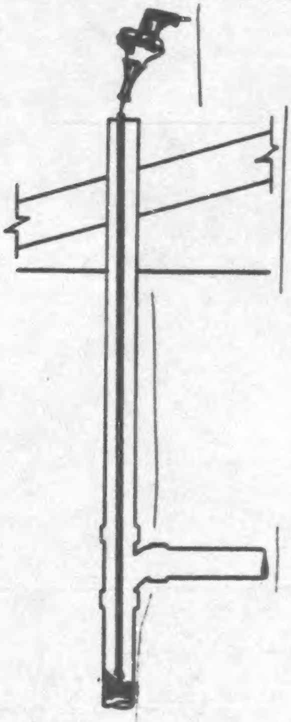
a. ______________________



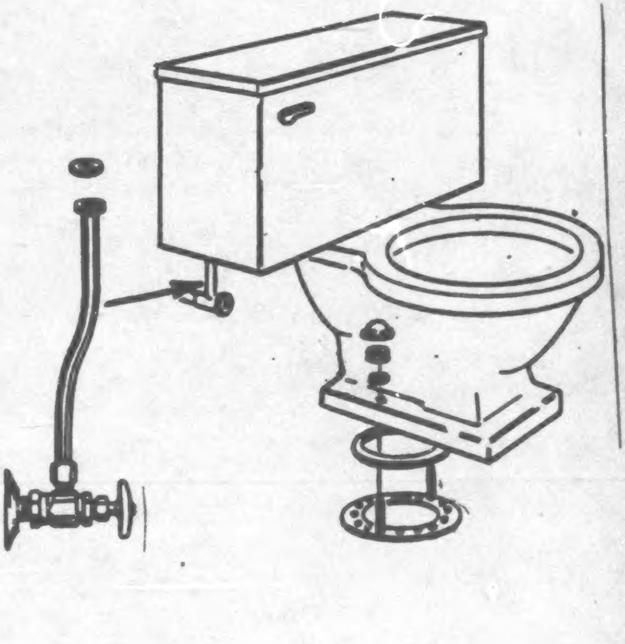
b. ______________________



c. ______________________



d. ______________________



e. ______________________

4. Demonstrate the ability to
   - a. Replace a lavatory trap.
   - b. Clear obstructions from a lavatory drain.
   - c. Clear obstructions from a water closet drain.
   - d. Clear obstructions from a main drain line.

   (NOTE: If these activities have not been accomplished prior to the test, ask your instructor when they should be completed.)

DRAINAGE SYSTEMS
MAINTENANCE REPAIR
UNIT II

ANSWERS TO TEST

1. a. 4
    b. 3
    c. 1
    d. 2
2. a. Plunger
    b. Caustic chemicals
    c. Plumber's snake
    d. Trap and drain auger
    e. Closet auger
    f. Water ram
3. a. Clean-outs in sewer line
    b. Base of stack
    c. Traps
    d. Vent terminal
    e. Water closet
4. Performance skills evaluated to the satisfaction of the instructor.